

**TECHNIQUES OF
TECHNICAL TRAINING**

Techniques of Technical Training

By

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Foreword

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THE object of this book is to suggest ways and means by which instructors, technical teachers, training officers and works supervisors and managers can improve the technical training of the men in their charge and to emphasise that their task is not merely to instruct but also to train men in habits of thought and in qualities of character so as to fit them for their particular work in industry and for their part in the battle for economic stability. It well fulfils its object and the author is to be congratulated on doing a much-needed and worth-while job. He shows himself to possess a very sound knowledge of the theory and practice of teaching and very considerable practical insight and experience—a combination that is all too rare. He has drawn liberally on the experience he gained while conducting Service Training Courses in which during the war period large numbers of men had to be trained in new and complicated technical skills. Much of the valuable experience gained during this time has not yet been systematically applied in many training centres in industry and the book should be invaluable in helping to reduce this time-lag. There is very little literature available on the subject for instructors engaged in industry so that it is particularly welcome. It should provide a powerful stimulus to the instructor to study his art and to try out new ideas and new methods.

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H.R.M.

Introduction

A great many books have been written on the theory and practice of teaching, but very little has appeared for instructors engaged in technical training, many of whom are brought face to face with a class of apprentices, without having had any previous experience in the art of training men.

This book is based on practical experience and is intended as a guide to those general principles of training that can be applied to any course of technical instruction, no matter what the subject may be, or for whom the course is intended. It should be useful as a reference book during a training course for instructors or technical teachers.

Some sections of the book, e.g. Chapters VI and VII, are designed more particularly for those who have to supervise training, or for those who wish to become acquainted with a little practical psychology as applied to technical training.

During the past fifty years there have been great advances in methods of teaching technical subjects, partly through the ever-increasing demand for more and more technical education, and partly through the contributions made by the study of applied psychology. This book is intended as a stimulus to the instructor to study his art and to make his own special contribution to it. A good instructor will ever be on the lookout for new ideas and new methods. One of the biggest handicaps to a good training scheme is the 'seasoned' instructor, who has been instructing in his own way for years, and is impervious to new ideas. A great deal of valuable practical experience was gained during the last war in the techniques of training, as large numbers of men had to be trained in new

and complicated technical skills in a short time. Instructors were put through a two weeks' course of 'Instructional Technique', or 'Methods of Instruction', planned and run by experts. Much of the useful experience gained in Technical Training in the Services has not yet been systematically applied in many technical training centres in industry, although good progress has been made through the Government-sponsored 'Training Within Industry for Supervisors'—or T.W.I. as it is called.

In recent years three training colleges for the training of technical teachers have been established in London, Huddersfield, and Bolton, but these can deal only with a fraction of the number who apply for training and a much smaller fraction of technical teachers who would greatly profit from such training.

Under the powerful stimulus of war, when large numbers of trained men were desperately required, it was found that 80 per cent. or more of the skilled jobs in industry could be learned fairly satisfactorily by keen men in a fortnight. By the use of practical and intensive methods of instruction, men and women who had never before been inside a factory could satisfactorily carry out skilled operations after a few weeks' training. Normally such achievements were believed to be attainable only after some years of apprenticeship. Intensive methods are not ideal, but the results achieved helped to focus attention on the value of scientifically planned training methods.

A book of this sort cannot be expected to turn all bad instructors into good ones, but it is nevertheless essential at the start to refute that mischievous doctrine that a good instructor has some sort of divine gift denied to other men. The 'gift of the gab' does appear to be inborn in many people, but this must not be mistaken for an ability to instruct. Instructors are in fact *made* not *born*. There are techniques of instruction, which have to be studied, learnt

and practised. The more common errors have to be brought to the notice of all who aspire to proficiency. For example, instructors on the whole tend to talk too much. They frequently indulge in over-long periods of continuous talking as this practice requires less preparation and teaching skill than planned class activity. Principles of class comfort are often lost sight of, and visual aids, including films, are often used ineffectively because they are used without discrimination or skill. It has been shown by carefully conducted experiments on actual classes under instruction that the speed and success of technical training depend very largely upon the methods of instruction. There is a good deal more in a piece of good instruction than meets the eye.

Courses are being organised all over the country in a vast variety of subjects, from Safety at Sea to Dressmaking, and experts are frequently called upon to run such courses at short notice having had little or no previous experience as instructors.

Although the techniques used in training require a good deal of pedagogical wisdom and experience yet the whole subject is really a common-sense application of those principles of teaching and man-management which have proved to be most effective.

A specialist in a subject is not necessarily a good instructor in that subject. Expert knowledge and skill are, of course, essential in a good instructor, but there are other essentials if the instruction is to be efficient, useful, and a practical contribution towards the larger object of all training, namely to make the man on the course a better man *at* his job, and a happier man *on* his job.

CHAPTER I

The Background to Training

INTRODUCING THE NEW WORKER

The training of a young man, or apprentice in industry begins from the moment he arrives at the gates of the works. He must from the start be made to feel that he is joining a team, and that he has an important part to play in that team. To ensure this the company should appear interested in the applicant and should obtain in advance, if possible, all the essential facts about a candidate before any interview takes place. This is conveniently done by means of an employment application form, which not only helps the interviewer, but serves as a basis of the man's record and future progress reports. (See Chapter 6.) Forms vary considerably depending on the grading of the post, but usually include:

- (1) Personal particulars. Name, address, sex, age, married, single, children, physical fitness, etc.
- (2) Education and training.
- (3) Type of job required. Alternatives. When free to start.
- (4) Previous employment. Rates of pay. References.
- (5) Military service. Dates. Branch of service. Service trade. Rank.

This form should be clearly worded and kept as simple as possible. If completed at the works, someone from the Personnel Department should be available to give any guidance or answer queries.

Early impressions are important, and so the reception should be courteous, and any directions given should be

clear. Attention to detail will be amply rewarded: for example, the waiting-room for receiving prospective trainees should be reasonably well furnished, and equipped with a mirror, and writing materials for filling in any forms necessary. The film *Introducing the New Worker** deals excellently with these points.

A new man selected for training should at the earliest opportunity be given a glimpse of the whole purpose of the works or industry, and its relation to everyday life and its importance to the community.

The Induction Course. He should if possible be given an induction course during the first few days of his arrival, to build up a feeling of confidence in the firm and its management. The course should make clear how the trainee's work will fit into the whole organisation, and would include the following:

Welcome by company official. A short history of the firm. How it is organised. How departments are connected. The firm's products and how it serves the community (in an automobile works a trainee should, for example, be given a chance to ride in the final product to appreciate the accurate and skilled workmanship). The works library. Connections with other firms, and with other countries. The Regulations, including those on Health and Safety, why they are made, and why they must be kept. Canteen, welfare, and recreational facilities. Social and sports clubs. Advancement and promotion, and how to set about further special training or education, for example, under the local education authority. Possibilities of transfer to other jobs in the firm or outside. Whom to go to if in difficulty. Outline of the training course to follow.

Some instructors, recollecting their own experiences on joining, feel it their duty to take the 'mike' out of new arrivals and to put them in their place. This is unwise. Let them come to the dirty, unsavoury and tough parts of their

* Made by Public Relationships Films for C.O.I.—Ministry of Labour.

work in the natural order of events. It is bad psychology and therefore bad training to give men hard and meaningless jobs when you are trying to teach them a technical subject.

The new trainee should have an early opportunity of meeting those at the top responsible for his selection and ultimate advancement and also some of those with whom he will be working. Ensure that he gets to know the right group, and does not fall into bad hands at the start. The whole object of training can easily be undermined by the born grouse and the disintegrating elements in the shop or factory, who regard newcomers as a heaven-sent audience. A word or two in the right quarters can generally put into operation a sponsor system, whereby a man of influence, happily adjusted in his own life and in the job, can be encouraged to 'Sea daddy' a beginner. In larger firms the Training Officer will naturally keep an eye on young workers and gain their confidence so that they feel they can go to him in any difficulty.

Confidence in the top is essential in trainees no less than in workers. The training of employees demands the most careful study and attention by industry and training in its fullest sense includes further education, widely based, so that the employees become more skilled in their work, happier on the job, and are made aware of opportunities for advancement.

A great many semi-skilled jobs are ignored in training schemes in industry as not being worth the trouble.

This attitude is not justified by experience. Planned training for all levels of skill is of great value in industry, not only for the improvement shown, time saved, and reduced accidents, but because a man's morale is enhanced by his being given a course. He becomes a happier man; he feels and, therefore, works the better for it. The firm, he feels, attaches some importance to him and his job.

The quite common practice of putting a learner to work by the side of, and under the vigilant eye of, an old hand is

not always the best way. The old hand be may quite unsuited as an instructor. He may not be inclined or able to give the necessary time to the task, or he may have undesirable tricks that are better eliminated than perpetuated. He may even be reluctant to pass on the tricks of the trade. He may enjoy his superior skill and may unconsciously wish to maintain his superiority unchallenged.

THE LARGER OBJECT OF TRAINING IN INDUSTRY

Sound training imparts not only a way of doing, but a way of thinking, so that a trained man confronted with a situation acts wisely and quickly. For example, he will deal with a complaint or a problem effectively. 'Work out all the facts'. 'What is the right course?' 'Is it honest? Is it free from selfish ends?' 'Is it going to make for better understanding and team-work?' He will plan with a clear head. 'What is the object I want to achieve?' 'How can I achieve it?' 'What are the snags?' 'How can I overcome them?' 'Time?' 'Materials required?'

A man's training goes on throughout his employment with new jobs to do, new machines to handle and new people to manage.

The instructor's job is not merely to instruct, it is also to train men, and training involves much more than the acquisition of skills and facts; it involves habits of thought, relations with the boss and with fellow workers, reliability on the job, initiative, leadership, in fact everything that goes to make up a skilled, competent, reliable man, with an influence for good in the shop or office.

All this may seem too ambitious for the ordinary instructor, but it is nevertheless essential that this larger object of training be kept in mind if he is to carry out his full responsibilities effectively. This approach should make the instructor's work a vocation rather than a tiresome burden.

Some essential qualities are caught and not taught. Many

problems which are accepted as technical problems are in reality moral problems. For example, in a certain naval training establishment during the war the care and maintenance of batteries in landing craft were taught efficiently, resulting in a high percentage of the class passing out with good marks. Operational reports, however, showed many failures, which were attributable to neglect by men who, technically, had high marks on the course, but who were not up to the mark on reliability, sense of duty, or responsibility. Care of batteries, like thousands of other jobs in industry, is not only a technical problem, it is also a *moral* one. It is of little use to preach or to teach team-work, reliability, sense of duty, and so forth. These qualities are *caught* and not *taught*. Caught from the environment, and particularly from the instructor. This aspect of training is most important and must be appreciated before the techniques of training can be properly assessed.

A man is not truly happy unless he finds an outlet for his personality and energy through his work. In the actual day-to-day training programme, we shall see that opportunities will present themselves for the instructor to develop in the class a sense of loyalty, team-work, initiative, a sense of duty, cheerfulness and perseverance in the face of difficulties.

It is these qualities which bring men to the top of their professions, and opportunities should be provided to develop them during training. The instructor is called upon to be a leader and an example. Smart stories of how you used to cover up a bad piece of work or pass the buck on to the next process, may illustrate your technical point, but they do not contribute to the larger object of training.

TRAINING WITHIN INDUSTRY

In recent years it has been found that good supervision increases productive efficiency, and supervision can be improved with training.

The Ministry of Labour and National Service has therefore sponsored a scheme known as 'Training Within Industry for Supervisors' or T.W.I.

In industry a heavy share of the burden of technical training falls on the foreman or supervisor who must be capable of (1) instructing new workers (job instruction); (2) handling men and dealing with problems of human relations (job relations); (3) maintaining a scientific attitude to methods of work and the problem of efficiency (job methods).

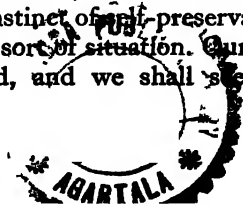
The training is largely concerned with giving supervisors a new outlook and attitude towards their important responsibilities, and the method of group discussion (page 157) is extensively used. Instructors should be given every opportunity to keep pace with new technical and organisational developments, and to this end refresher courses should be run wherever necessary.

Workers selected for part-time instructional duties should not suffer any financial hardship through loss of bonus or overtime as this would be a poor reward for their being selected as instructors.

You Teach not only a Subject but a Person. It is a help in keeping the aim of training in view to realise that you teach a subject to a person with a mind, a will, a personality, and a character.

HOW WE LEARN

An instructor must have the *attention* of his class. The only way the mind of a person can become aware of, or take in a fact or a situation, is by *attending* to it. We attend to situations we are *interested* in. A tiger looking in through the window would instantly demand our attention, because for some reason or other (some call it the instinct of self-preservation) we are specially interested in this sort of situation. Our self-preservation is clearly concerned, and we shall see that



whenever a basic instinct is linked with a situation, our interest is guaranteed, and attention is inevitable.

Some instructors endeavour to secure attention by shouting to keep the class roused, or by threatening the class either by harsh words or an eagle eye. 'Attention' so achieved is of little value. The trainee puts on an air of attending, as a sort of defence mechanism, with a glassy stare fixed on the instructor and a mind miles away.

Some instructors gain the attention of their class (attention of a sort), by making jokes in season and out of season. Beware of being the funny man. Jokes and amusing anecdotes about the work have their place, and are often a good means of rousing interest, as we shall see later, but the great danger is that although attention is secured by the class waiting for the next joke, interest tends to shift from the subject of instruction to the instructor-comedian.

Attention through Interest. Attention is the responsibility of the instructor, or to put it more tersely, 'Inattention is the instructor's sin'.

The instructor's job is far more than standing before a group and delivering a series of correct statements about the subject to be taught. Lectures, talks, discussions, demonstrations, and practical exercises must be made as interesting as possible, by all the devices in the instructor's stock in trade, as will be shown in Chapter III.

Our interests derive their power from our fundamental instincts or their emotions. Consider, for example, how popular films and novels appeal to a major instinct such as sex or hero-worship. Contrast the ease and pleasure with which a boy for example can rattle off a list of Cup winners since 1545 with his painfully poor performance say in listing the Kings of England—although the history master has done his best for weeks to induce the boy to assimilate this knowledge. Hero-worship is strong in boys and amounts

almost to an instinct, so that they are vitally interested in their hero's batting average or the fortunes of the Arsenal's captain. They identify themselves with their heroes. Their self-esteem is enhanced (the self-regarding sentiment is, or should be, strong in us all), they are interested, therefore they attend; the impression goes deep and they remember the facts of football.

Memory is good only where there is attention through interest. In fact it is a good adage for the instructor to bear in mind that there is no such thing as bad memory, there is only bad attention. In technical training the motivating force, which makes the trainee want to learn, and which supplies a background for interest, is this self-regarding sentiment which as we shall see in Chapter IV takes a variety of forms and shows itself as pride in one's work, the pride of the craftsman, the love of creating and the instinct of self-display. We like to regard ourselves as good useful people, and feel bad about failure and loss of face.

All these feelings are generally heightened if a man has a family, and perhaps parental responsibilities.

Pride in one's work and desire to 'get on' are right and proper incentives or 'motivators' and ensure a measure of interest in a dull subject, even with a boring instructor, for whenever there is interest, no matter how obtained, there is attention. A man who has not a well-developed self-regarding sentiment and has no urge to get on or to express himself in his work is a real problem not only to the instructor but to himself as well.

Many of the subjects taught under technical instruction are not in themselves at first sufficiently interesting to hold the attention of say a random group of young men, unless the subject-matter can be linked with a major interest which acts as a motivator.

What spurs a trainee on, especially to do private study or voluntary practical work, is the thought he entertains of

himself as a qualified mechanic, or a chartered engineer, and the loss of face entailed in failure. This self-motivation can, and often does, operate in spite of an unimaginative or even boring instructor. An enthusiastic and skilled instructor can, however, make his subject *intrinsically interesting*, so that the trainee develops an interest in the subject which is over and above the interest which comes from his self-esteem and the desire to get on. The drive from the desire to get on and the pleasure from intellectual exercise and achievement reinforce one another. (Incentives and motivation are dealt with more fully in Chapter IV.)

INSTRUCTION PRINCIPLES SUMMARIZED

The instructor must understand the larger object of industrial technical training, and keep this object in view at all times.

The class must be motivated. They must be encouraged to want to learn. Our innate desires to get on, to be thought well of, to belong to a community or to help our family, are mainsprings of our conduct. They motivate and ensure interest. Interest commands attention.

THE VARIOUS STEPS IN A PIECE OF INSTRUCTION

We may now anticipate the next few chapters which deal with the basic principles of instruction in the order in which they have to be dealt with by the instructor. These steps can be recognised in any piece of instruction, whether it be a lesson, lecture or demonstration.

(1) *Object*. Know what you are aiming at. The object of training must be kept in mind. The object of a particular piece of instruction must be clear and definite.

(2) *Preparation*. The effectiveness of the instruction depends on the preparation.

(3) *Presentation*. Putting it over. The instructor regarded as the producer, stage manager, star and scene-shifter.

(4) *Reception*. Taking it in.

(5) *Assimilation*. The class taking an active part in instruction and inwardly digesting what has been presented.

Technical training must be a part of a man's education. Apprentices soon become set in their ways. Be always on the look-out for opportunities to develop character. A man can be highly skilled in his job, but if he is unco-operative or indifferent to the fate of his colleagues in the firm, is unreliable and unpunctual, he is a menace in the works—in spite of his technical skill.

CHAPTER II

Preparation

The success of a piece of instruction depends on the preparation. The more you plan and prepare, the deeper the instruction goes.

Preparation includes: preparation of *subject-matter* to be taught, its selection and arrangement; preparation of *demonstration material*—apparatus, diagrams, etc.; and preparation of the *minds of the class* so that the new work becomes grafted on the old, facilitating understanding and a logical growth of knowledge of the subject.

This chapter will notice some of the basic principles of teaching as these must be observed at the preparation stage.

Here are examples of instructors at their work. (This could be put on as a playlet in a course for instructors to illustrate the difference between the instructor who is prepared with a clear objective and an instructor who has no clear objective. Incidentally, in any course for instructors it is an excellent idea to intersperse playlets in the programme to show how much more effective they are than mere talk and chalk. See Chapter VIII, p. 163.)

A works manager or head of a technical department walks round on a tour of inspection and comes across a class of apprentices just about to commence instruction. He asks the instructor what the course is and what particular piece of instruction is about to begin.

The replies may be:

(a) I am going to give the class something on machine tools.

(b) I am going to carry on with batteries.

(c) We are going to continue the electricity course for electrical mechanics.

Or

(A) I am going to demonstrate how the angle of the cutting tool affects the quality of the turning.

(B) This morning I am going to break down some concentrated acid and measure acid density and show how this changes with temperature.

(C) We are now going to trace the circuit in the cutout and voltage regulator and practise making adjustments on an actual car.

(a), (b) and (c) had only vague and generalised objectives. (A), (B) and (C) had clearly defined and limited objectives.

A class either from enthusiasm or boredom will often try to lead you away from your objective even when you have it clearly defined and in mind.

If you do not know exactly what you are trying to do there is little hope of your doing it, and you can never test what you have done.

THE OBJECT

The instructor's first task in preparation is to get quite clear in his own mind what the object of the course of instruction is, and what the object of each period of instruction is to be.

The general object of training may have five aspects which are often closely interrelated.

I. To motivate the trainee. To stimulate interest in his particular job, and in his future.

II. To impart the necessary knowledge of his work including background, theory, and related subjects.

III. To impart the practical skills and techniques of the work.

IV. To train men in principles of team-work and right human relations so that the proper conditions for willing and loyal co-operation are encouraged between all personnel in all departments.

V. To provide the means for making a clear assessment of the trainee's ability and aptitude for a particular job so that a useful grading of the men results, and a proper selection of men for advancement can be made.

In dealing with the object of a piece of instruction at the preparation stage, it must pass the test of being *practical*; *useful*; *definite* and *limited*. It should in addition be in harmony with the larger object of industrial training, and touch the trainee's outlook, his character, and help him to be a better and happier man on the job, in the social club, and at home.

WHAT TO TEACH

This may be defined by a set syllabus, but the instructor should know much more than he is expected to teach.

It is a common mistake in instructing to attempt to impart too much information, particularly too much detail, in the limited time allowed. As a result trainees often carry away a confused idea of dozens of facts—possibly important to an expert, but not essential in a first course. It is far better to teach a little thoroughly than attempt a lot superficially. Basic principles are more important than details. You should, therefore, work out the actual content of your instruction, i.e. the things to be included, by applying a system of priorities on a simple plan.

In all technical subjects there is an essential core of knowledge or skill that a trainee *must* know. Make this the *must* of your instruction. Then there are the valuable and interesting parts which a trainee *should* know if there is time. Finally, there are the trimmings of the subject, that are often elevated for no apparent reason to important places in the syllabus. Details concerning the weight of parts of a machine, for example, are often included whereas the man who has to lift them has a much better idea of the

weight than can be conveyed by a statement that the part weighs '20 lb.'

The frills of the subject are often a great temptation to an instructor who feels he must display a superior and detailed knowledge at all times. The trainee *could* know these details if time permitted, without detracting from the proper stress being laid on the *must* and *should* parts.

Training programmes are invariably limited by time, and therefore the total amount of matter that might be taught should be sorted out into these three categories, of what the trainee *must* know, *should* know, and *could* know.



FIG. 1

Seemingly unimportant points in the *could* know category can sometimes be raised in priority on the grounds that they rouse interest, or motivate the class or contribute to the larger object of training. In actual practice the instructor should make a list of points in order of priority with the time to be devoted to each. When the time has been used up draw a line. You will have to leave out items low in the scale of importance.

A Simple Example. Suppose you have ten minutes in which to teach your friend how to handle a motor-cycle as a result of some emergency. He can ride a cycle and drive a car, but has no previous experience of a motor-cycle; then your list might look something like this:

	<i>Time allotted in minutes.</i>	
Sitting on, and getting feel of machine	$\frac{1}{2}$	} <i>Must know</i> 8
Switching on petrol and starting engine, throttle and air controls, including demonstration by you	1	
Clutch and gear changing (machine on stand)	1	
Brake operation, and safety precautions	$\frac{1}{2}$	
Actual practice on road under super- vision	5	} <i>Should know</i> 2
Lights, horn	$\frac{1}{2}$	
Checking oil and petrol. Position of tool-kit, cleaning plug	$1\frac{1}{2}$	
Place of: Puncture repair outfit. Pump. Cleaning carburettor jet. Magneto contacts. Fitting spare bulbs.		} <i>Could know</i>

SEQUENCE IN PRESENTATION

Although the presentation of a lesson is dealt with more fully in Chapter III it is necessary to consider here the sequence in which material is presented, as this sequence must be thought out in advance, and is therefore a part of preparation.

The important rule is: *Start within the Trainee's Experience.* For example, in an elementary course on electricity, start with homely examples, domestic appliances, before going into complicated appliances used in the works. Adjust the tappets on Smith's motor-cycle, before dealing with the tuning of a large diesel engine.

Prepare the class for new material, which should be 'grafted' on to the old. Revise what should be known, so that you are sure of the foundation on which you are building. Revision should be clear and methodical. Most subjects have a logical development, and any gaps in back work seriously hinder progress. This is particularly true in mathematical subjects in which progress depends on a good grasp of previous work.

Now suppose that, with the object clearly in mind, you have decided *what* to teach. The next step is to arrange the matter in the order in which it should be taught. The sequence rules are well known to schoolmasters, and apply to technical instruction. They are:

Proceed from the known to the unknown,
from the simple to the complex,
from the concrete to the abstract,
from the particular to the general,
from observations to reasoning,
from the whole to the parts, and back to the whole.

A course on the gyroscopic compass, for example, could begin with a toy top with which the class is familiar.

It is more instructive to observe, collect evidence, and get the class to deduce a principle or rule, than to state a rule and then set about finding examples.

A sequence which serves instructors well in teaching a great many skilled operations is: (1) explain; (2) demonstrate; (3) class imitate; (4) practise; with proper emphasis on the last two, as we shall appreciate later.

As a general rule a piece of intricate mechanism should be understood as a whole in very general terms, then analysed into its various main parts, and then it should be *built up* bit by bit into its main parts, and then shown fully assembled as a whole.

Sequence is mainly a matter of common sense, but it is not invariably true that a strictly logical sequence is the

best one. For example, a logical way to teach a language would be to begin with the alphabet, then words, then grammar, then sentences, but a trained language teacher does not follow this method today. Language students usually start by attempting to speak meaningful sentences. A child learns to speak a language before learning the alphabet and the grammar. Thus the psychological order for teaching some subjects has precedence over the logical order.

In technical instruction, a point frequently overlooked by instructors is that the mind needs frequent pauses and rests even in a forty-minute period of instruction. This will be dealt with more fully in Chapters V and VII, but as far as sequence is concerned, it is worth remembering that planning a lesson is rather like writing a letter. The main point of the letter should be made either at the beginning, after a suitable opening, or at the end. Anywhere in the middle, it is liable to be regarded as of less importance.

It is interesting to draw an analogy between the learning process, and the process of digestion. You cannot eat non-stop for an hour, but you may manage satisfactorily a banquet of five or six courses, with the usual intervals between courses. Your instruction should not be without pause of some sort. You must allow time for the class to digest mentally what they have taken in, and put the 'courses' on in the psychological order, in much the same way as a chef plans a menu. The analogy stops here. A good dinner usually leads up to the main dish, the *pièce de résistance*, somewhere in the middle, but in an instruction period, it is generally found that interest, and therefore attention, is at a low ebb in the middle of a period. A graphical representation of how the attention of a class fluctuates with time is shown in Fig. 2. Interest starts off well, though no matter how good the instructor may be, there will never be full attention from all the class. Interest drops. Fatigue and

boredom set in, and persist until banished by the pleasant anticipation of the end of the period. The real attack on the main objective of the lesson should therefore take place when attention is at its highest: that is soon after the start, or else at the end. It is here that you arrange the *must know* part of the instruction. Of course there are exceptions, and the

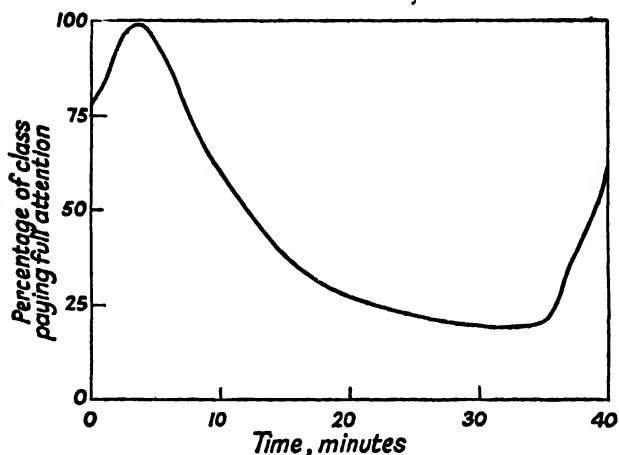


FIG. 2.

shape of the curve in the hands of a good instructor can be modified almost at will. Your pauses 'between courses' for digestion can be made by making blackboard summaries, or presenting the difficult points in a different way. Questions provide an opportunity for assimilation. These pauses should occur every ten or fifteen minutes.

Prepare the end of your instruction, so that you leave time for questions by the class, and time to hammer home a final summary, definite and clear, bearing directly on the object of the lesson. Leave time if possible for the class to give back what they have taken in. 'There is no impression without

expression: 'you do not know a thing until you are able to explain it to someone else. There is no need to elaborate this point; it is relentlessly borne home to instructors whenever they attempt to teach a piece of work for the first time.

THE PREVIOUS KNOWLEDGE OF THE CLASS

Proper preparation for a new class is possible only if you know what stage in the subject the class has already reached. It is most unwise to assume that a man knows nothing. One often hears it remarked by the old-time instructor, 'I always assume they know nothing. I know where I am then.' This may be sound in teaching men a special works process that the trainees could not possibly have learnt elsewhere, but it should not be assumed that previous instruction given by others is of poor quality, and must therefore be done again. It is easy for an instructor to catch a class out on a few small points, and then deduce that they know nothing about the subject. Such an attitude is disloyal to other instructors, and there is nothing more boring to a class than going over familiar ground. If a class is a little rusty on a subject, do not dismiss the whole of their past instruction as worthless. Recapitulate patiently. Learning and recalling will be rapid the second time and will give the class some confidence in themselves and in you.

It is of course equally wrong to assume previous knowledge that you are not sure the class has even attempted. In the practice of instruction, we shall frequently meet with the wisdom of the middle way between two extreme views. (See Chapter III, p. 44.)

The best course to take is to find out what the new class knows. This can be done either by asking questions at the first opportunity or, alternatively, as soon as the class is assembled, by a test, either written or practical, depending on the subject of instruction. The test can be, for example, a simple alternative-answer-type test, which can be marked in

a few minutes, and the results declared. A somewhat light-hearted test given by the author to a newly assembled class of instructors is reproduced on page 91. The class took the test on the first day of the course, and at the end; in all cases there was a marked improvement, which incidentally gave a demonstration of how to produce a feeling of achievement. Try it now, and then repeat the test after reading the rest of this book.

WHAT PACE CAN THE CLASS STAND?

A valuable rule has already been mentioned on page 27. It is better to teach a little well than a lot badly. A man can take in only a limited amount in a particular time; increasing the pace or the lecturing time, or the number of periods, will not necessarily increase the amount learnt and assimilated. There may even be a decrease in the overall achievement if the mental saturation-point is reached.

Another good rule is that it is better to go the pace of the bottom half-dozen in the class rather than the top half-dozen. The reason for this is that if you go the pace of the brightest those at the bottom will be lost, and will go from bad to worse, but if you bring the slower group along with you, the top will certainly be with you and you can save them from boredom by giving them more advanced work from time to time or getting them to assist with the practical demonstrations. Whatever the pace, the instructor should always be fully prepared in his subject. The class sees through a shallow instructor who contrives to keep just ahead of the class.

In the preparation of material every opportunity should be taken of improving your own knowledge of the subject. It is very easy in these days of rapid technical development to be out of date, or lag behind some advance that the class has heard about through books and periodicals. You must be able to stand up to all reasonable questions on and around

the subject. You will not go far with your class unless you have their respect and confidence, as a man who 'knows his stuff'.

'SENSE APPEAL'

You now have the object of the whole course and the object of the lesson clear. You have found out just what the class knows, and you have a good idea of what the class can take in at a time, and at what pace you can go. You have arranged the subject-matter in order of importance, and decided what the class *must* know. At this point you are ready to deal with the actual problem of devising ways and means of 'putting it across'.

The best way *may* be a straightforward lecture, consisting of forty minutes' talking from you, but this method is more likely to meet with success in a course for an arts degree at a university than in a technical course in a factory or technical college, where the training must be practical. Men have to be taught to work and act, and therefore the best way of instructing is to use methods that actually train men in the work they have to do. Methods of training that are remote from a practical application of their skills and knowledge, are largely a waste of time for the class and the instructor. In Chapter VIII various kinds of instruction are further considered.

We have five senses: *touch, seeing, hearing, smelling, tasting*. These senses are the gateways to the mind, and all play a part in the technique of instruction. The rule is, use as many of the senses in your instruction as you reasonably can.

The sense of *touch* plays a very important part in many parts of technical instruction. We often have occasion to talk about the *feel* of a thing, and whenever it is relevant the trainees should be allowed and encouraged to handle things that have a characteristic 'feel'.

The qualities of surfaces, and abrasives, can only be

explained by feeling. Suppose a lady wanted to teach you the difference between a pair of nylon and a pair of rayon stockings. A verbal discourse on the subject would convey practically nothing; samples of each could be produced, and the difference between nylon and rayon could be *shown* to you. Still there is no clear idea what the difference is. The real difference is to be appreciated by feeling a pair of each, and as soon as you have experienced this, the senses of touching, seeing and hearing, join together in making the distinction clear to you.

Smelling and tasting do not come into many branches of technology, but whenever the materials of a subject have a distinctive and harmless smell or taste, let the class smell and taste them. Cookery, chemical engineering, food technology, safety courses and sanitation, might well use smelling and tasting in their courses. Some important pieces of information on these subjects cannot be conveyed in any other way.

THEORY AND PRACTICE: KNOWLEDGE, SKILL, TECHNIQUE

We are all familiar with the division of instruction into theoretical and practical—often unfortunately spoken of as if they were constantly in opposition. It is often said in a derogatory way that such and such a person is not much good as he is a 'theoretical' man, as opposed to a 'practical' man. This is an unfortunate distinction as there is no real opposition between theory and practice in any technical subject. If there *appears* to be, then the theory is not correct, or it has not been properly applied. If the full and proper theory be applied in detail to any practical problem, then perfect agreement will be reached. *Sound theory is sound practice conscious of itself, and sound practice is sound theory unconscious of itself.* The three types of instruction can be recognised by their aims.

(1) Imparts facts, and *knowledge*, in an organised manner, about a technical subject. This is the usual theoretical side of instruction.

(2) Imparts *skills*. This involves muscular dexterity, and co-ordination of mind and muscle. This is essentially the practical side of instruction.

(3) Imparts *techniques*, which can roughly be defined as an ability to use knowledge in a practical way, and make use of skills. Techniques are a combination of theory, skills, and a way of thinking.

An example will illustrate this more clearly.

A man decides to take up driving a car. He buys a copy of *How to Drive a Car*, and a copy of the *Highway Code*. He learns all about the internal combustion engine, starting, stopping, throttle, clutch, brakes. He learns the rules of the road, and all the signs of policemen and traffic lights. He acquires considerable knowledge.

Next he is given a practical demonstration in a car by a friend, and is allowed to 'practise' in a large field. He starts the car, changes gear, turns round and acquires considerable skill in handling the car at various speeds, always in the large field.

All would agree that he is not yet at the stage when he should be let loose on the public and allowed to drive the car in London, say from Marble Arch to Fleet Street in the rush-hour. Skill in handling the mechanical parts of car, and a knowledge of car and highway code, have to be fused together in actual experience into a way of behaving correctly under varying circumstances. This produces a good driver, i.e. one who has acquired a *technique*.

We shall now see how *knowledge*, *skills* and *techniques*, each have their own needs in regard to 'sense appeal' in instruction.

Knowledge, involving facts, theoretical principles, should be taught using as much appeal through the eye as possible.

It has been estimated that we gain about three times as much technical information through our eyes as we do through our ears, and hence the emphasis that must be made on good models, instructional diagrams, good blackboard work.

A boxer knows that one in the eye is worth three in the ear. This holds good in instruction. At the preparation stage always try to increase the appeal to the eye, and minimise the actual talking. I believe it was Confucius who said: 'One picture is worth a thousand words'. Use posters, blackboard, charts, film-strips, models, or the real thing. (See Chapter X.)

In teaching a *skill* from scratch, the emphasis must be made on *learning by doing*—using muscles, co-ordinating mind and muscle, developing the 'thinking hand' as it has been called.

In each case the instructor's voice plays only a small part, but nevertheless an important part. This is not an attempt to belittle the instructor; he is, even though not talking, of supreme importance at all times.

You can only learn a *skill* by *doing* it. The following operations are *skills*, and can only be learnt by *doing*:—armature winding, turning, riding a bicycle or a horse, skating.

In teaching a *skill*, talking should be severely restricted to a few points such as why the skill is important (to motivate the trainees), safety precautions, and any essential mechanics that will help in the learning. After that *talk and chalk* must give way to *learning by doing*, by the trainees, with the instructor more or less gagged but standing by to help where necessary.

During the war, an investigation was made of the way technical instructors, teaching physical skills, actually spent their time, and how they *should* spend their time for best training results. It was found that instructors on the whole explained matters for 59 per cent. of the time, demonstrated

for about 25 per cent. of the time, and the class practised for 16 per cent. of the time, as shown in the diagram (Fig. 3).

This is probably a fairly common allocation of time used by a great many instructors. Then, by means of scientifically planned experiments with groups of men, using some control groups to eliminate any disparity in the learning rates of different groups, it was found that a class learnt a skill best

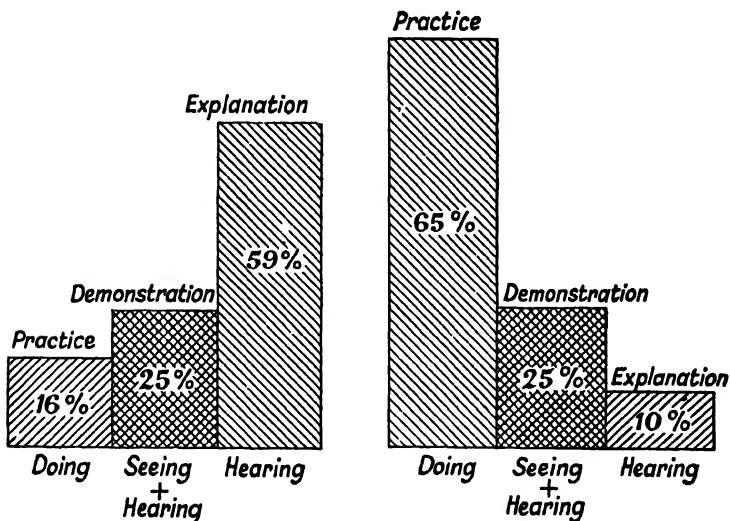


FIG. 3.

FIG. 4.

FIG. 3. WHAT THEY DID : FIG. 4. WHAT THEY SHOULD HAVE DONE

when explanation, demonstration, and practice were mixed in the proportions: explanation 10 per cent., demonstration 25 per cent. and practice 65 per cent. as shown. (Fig. 4.)

This confirms the point already made that an instructor generally includes too much talking in his programme.

In learning a *skill*, it has been fairly well established that practice, or the actual use of hand and muscles, is nearly three times as important in the time table as demonstration,

or using the eyes; and that explanation, or using the ears, is of comparatively small importance in the learning process.

In learning a *technique* (e.g. as driving a crane), which, as we have seen, generally depends on knowledge, physical skills and habits of thought, the important thing is *practice*. Explanation and demonstration can take the trainee a little way along the training path towards a technique, and no more. Beyond that, explanation and demonstration become a waste of time for all concerned. Techniques are acquired only through experience, so that when preparing a piece of instruction on a technique make plenty of provision for the men to 'have a go' as soon as the basic knowledge involved in the technique has been acquired.

The diagram (Fig. 5) on the succeeding page will illustrate how we learn through our senses.

CHECKING A FEW POINTS AT THE PREPARATION STAGE
Matter, Materials, Minds

Keep the overall *object* of training in mind.

Is the immediate object of the instruction clear and limited?

Does it fit in with the syllabus?

<i>Check Question</i>	<i>Decided by</i>	<i>Notes</i>
What does the class know already?	Questions, or a rapid test.	This should be settled well beforehand if possible.
What shall I teach?	MUST know. <i>Should know</i> Could know.	Job breakdown and analysis, note key points. Arrange matter in an order of importance first and then divide. Is it practical; useful?
How fast can I go?	Ability test.	Go the pace of the slower members, but keep the bright ones busy.

[continued on next page]

HOW WE LEARN

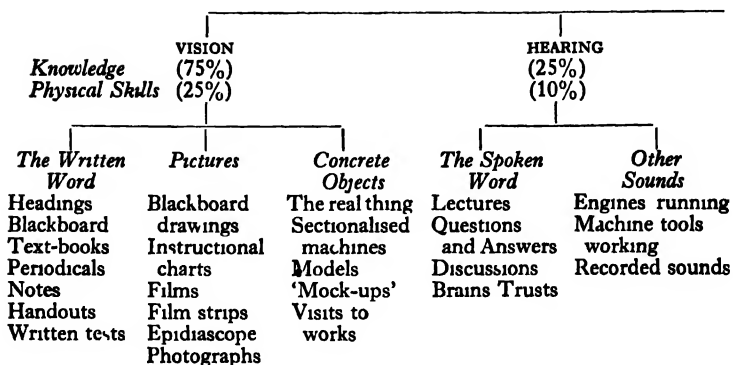
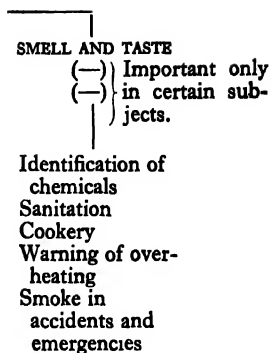
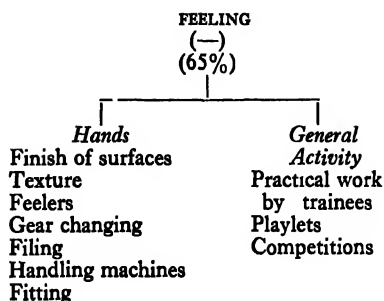


FIG 5 Use this diagram to see if you are making for instruction Keep the class as active

THROUGH THE SENSES



the maximum appeal to the senses when preparing as possible. In Skills we learn by *doing*.

CHAPTER III

Presentation

The object of this chapter is to put the instructor under the microscope, and to examine those personal qualities found necessary for good instruction, and then to consider how these qualities can be developed. Instructing and training men is a technique involving skills, habits of thought and knowledge, which can be studied and acquired just as any other technique. Some make better instructors than others, but all can improve if the art of instructing is regarded as a matter for study and practice, and not looked upon as a gift from heaven handed out at birth to some and denied to others.

The instructor has a great responsibility for laying the foundation of trainees' careers, for he can start men off on the right or on the wrong foot. He is very much concerned with the establishment of right human relationships, and this calls for a sound knowledge of the principles of management. Trainees are ruthless critics of their instructors. They know at once if you are bluffing or pretending to be something you are not. They can tell from your manner and chance remarks if you have a perpetual grouse against the high-ups, or if you genuinely put your job, your ideals, or your men before any purely selfish interests. You thus infect the class with your own attitude, outlook and enthusiasm.

This is largely a chapter of dos and don'ts; of good qualities to acquire, and pitfalls to avoid. In instruction (as in everything else) it is possible to have too much of a good thing as

well as too little of it, and we shall see that there is generally a sound middle way to be followed. Here is a catalogue of the virtues of *the Good Instructor*.

1. *He Must be a Man of Purpose*

He must know exactly what he is trying to do, and he must be able to persevere in doing it, so that he develops in the class a sense of achievement; this means he must know the feel of the class and be sensitive to its needs at all times.

2. *He Must Know his Subject and his Class*

The instructor should know far more than he is expected to teach. You cannot teach up to the limit of your knowledge effectively or safely; if you try to, you will sound unconvincing and may start to bluff. In giving a demonstration, the performance must be first-class, but bear in mind that years of experience in a profession or craft do not necessarily make you a good instructor. The professor of mathematics can be quite useless as a teacher of arithmetic; the superman in a subject can easily be quite out of touch with the difficulties of ordinary men. There is further the temptation to put on a dazzling performance to an astonished, gaping class. Skills and knowledge are not acquired through a mouth agape with wonder.

The importance of preparation has already been stressed. The instructor's superior skill and knowledge do not exempt him from preparation. Whatever the qualifications and experience of the instructor there is always a plan to be followed, matter and methods to be decided upon to suit the particular class. The steps of the instruction have to be worked out, summaries must be thought out, and a check made of all gear to be used to ensure that it is available and working.

When you have done all this, do not be hidebound, or a slave to a plan of the clock; be flexible enough to change your

plan of campaign if you feel that it is in the interests of the class to do so. Classes are like people; they do not all react the same way, so do not get into a rut with instruction that you feel you can give 'on your head'. Your class is not just an assembly of units on a conveyor belt going through a process.

3. *He Must be Enthusiastic*

Enthusiasm is infectious, and can make up for a number of deficiencies in a poor instructor. Over-enthusiasm, however, has its dangers, and may interfere with the balanced outlook of an instructor and obscure the larger object of the training. The works are *not* run for the benefit of instructors so enthusiasm must be tempered with common sense and a sense of humour. The deadliest bore is the enthusiastic bore.

The job of instructing is not suited to everybody; nevertheless, a man who at first feels that it is not for him can make a reasonable show at it by sheer determination, but real enthusiasm produces the outstanding instructor. The class reflects either the instructor's enthusiasm or his boredom. Enthusiasm is so much a matter of character and personality that specific advice about it is hard to give but without enthusiasm there is no driving force in the instruction.

You can and must conceal any lack of enthusiasm you may have for any particular piece of instruction, that to you may be uninteresting or even unnecessary. Do not betray your own lack of interest to the class. You may have heard this sort of talk:

'This course is a bit of a bore for everybody, but we all have to go through it, and if anyone slacks I will see that he misses next year's chance of promotion.'

'I am not going to stop this exercise of stripping down and assembling till someone in the class does something right by way of a change.'

'I haven't been able to get anything ready for you today, so I suggest you go through the calculations at the end of your books.'

Then there is the ten-minute break for tea that so easily becomes twenty minutes. The enthusiasm of the instructor must be able to counteract the pull of the canteen, both for himself and the trainees.

4. *He Must be a Good Showman*

In this chapter the instructor is considered as the chief character in the piece. He is also the producer, the stage manager, and the property man all rolled into one. From the moment he steps in front of the class the performance is on, and the instruction should run smoothly from beginning to end, with no hitches or breakdowns. You can probably recall the unpleasant jarring that occurs when the projector keeps breaking down in a cinema. The film may be good, but the effect is lost if it does not run smoothly. The instructor must have dramatic sense, and a feel of the audience: this means that he should know how to drive home his points by a well-timed use of the element of surprise, variety and an occasional good gag. Without a good sense of audience, little surprises and gags can misfire through lack of spontaneity.

Establish the right relationship with your class as soon as you confront them for the first time by telling them your name; then ask each member of the class to tell you his name. Write the names down quickly *in their seating order*, so that you have a key to the names of your class, and their positions, in the first five minutes of your encounter. This gives you some control of the situation, an important contact has been made and there is a psychological significance in knowing a man's name and using it. A fixed seating arrangement is recommended for all classes of more than eight as it helps in learning and remembering names.

When you have to ask a question it is far better teaching manners and far more effective, to call upon Mr. Brown than to say 'You in the corner' or 'The big chap in the third row'. The name-key is indispensable for proper questioning of the class, as we shall see in Chapter V dealing with the art of asking questions.

5. *The Instructor Should be Seen and Heard*

This may seem fairly obvious, but it is surprising how often an instructor puts himself in a dim light, or is obscured from a part of the class, or can not be heard properly by all the class. A check of experienced instructors in a Service establishment showed that, for indoor instruction, about 12 per cent. of the class could not see the instructor properly and about 7 per cent. could not hear him. These figures go up considerably for outdoor instruction, or for practical instruction that has of necessity to be given in noisy or awkward places. Make sure that all the class can see you and hear you comfortably, and that you and your demonstration bench or blackboard are well illuminated. Any artificial light used should shine on you and not in the faces of the class. Class comfort is important and will be dealt with more fully in Chapter IV.

6. *Dramatic Sense*

Chapter I showed that attention was best secured through interest, and we have seen that one way of rousing interest is to use plenty of variety with little surprises, and an occasional touch of the dramatic. Here are some examples:

In teaching mechanics there are numerous pieces of gear that can effectively be produced to save the lesson from too much talk and chalk. The ordinary bicycle brought into the class-room can form the basic apparatus for explaining mechanical advantage, velocity ratio, and levers.

The element of surprise can be used when explaining horse-power. Invite one of the trainees, preferably of an athletic type, to run up two or three flights of stairs as hard as he can, and take his time by means of a stop-watch. Let the class see the performance. Measure the height of the stairs and weigh the athlete. Then return to the seclusion of the class-room, and work out the volunteer's horse-power during his effort.

$$\text{Horse-power} = \frac{\text{man's wt. in lb.} \times \text{ht. of stairs in ft.}}{\text{time in sec.} \times 550}$$

It will be about 1.5 h.p. This little surprise and break from routine provides class activity and gives the right idea about horse-power which the class is unlikely to forget.

In a course on Safety Precautions or First Aid, arrange for someone to enter the room with some excitement and announce: 'Old Thomson has had an accident. He is lying on the floor and looks as though he has passed out.' Use an actual prearranged situation to test how they would deal with the emergency in a practical way. Let the class do what they think best in pairs and then discuss what each pair did well and what they did badly. This idea could have a number of variations, not only to provide practice in first aid, but to demonstrate the importance of safety precautions, e.g. not starting electrical work without first switching off the current.

Safety precautions and dealing with emergencies are techniques that can only be learnt by *doing* and practice. You cannot learn a technique by studying a book, or listening to people talking. Make the instruction practical. Rouse interest by surprise, variety and a little good dramatisation.

Fire precautions and fire-fighting give plenty of scope for surprises and dramatisation. It is well worth letting off a few fire-extinguishers or smoke-bombs and clearing up a mess if the full object of the course is satisfactorily achieved.

7. *Timing*

A good piece of instruction, like a good sermon, should have an object, a good beginning, a few points, with the 'message' punched home at the end. Start on time and finish on time. It is doubtful if anything worth while is achieved if you keep your class past the time scheduled to stop, particularly if you encroach on the dinner-hour and there is a clock facing the class. Impatience and restlessness set in and prevent you from making an impressive ending, with the punching home of the points you set out to make.

A proper sense of timing can be developed only by experience. An actor knows just when to wait for the applause or laughter to die down before going on so that nothing is lost to the audience.

The instructor in a similar way gets the feel of his class. Any new and arresting fact should be followed by a very reduced tempo to allow time for this new idea to be turned over in the minds of the class. It would be ineffective instruction to follow up immediately with a rush of further important points.

Vary the method of approach to a difficult point, and slow right down till you are reasonably sure that the class is with you. Watch the faces. They are the dials of the machine you are in charge of, and they indicate whether your speed is too fast or too slow.

8. *Manner*

The term 'manner' is here meant to include how an instructor stands, moves about, speaks, uses his hands, eyes and expression. These will be dealt with under the headings: voice, eyes, mannerisms, stance, attitude.

Voice. Speak loudly enough to be heard clearly at the back of the room, but do not shout. Speak clearly and

distinctly, using your natural voice, and avoid any temptation to imitate the style of your favourite film star or politician. Speak slowly, but vary the speed, emphasis and tone from time to time to avoid becoming monotonous. We are very bad judges of our own way of speaking: if you have your voice recorded it is difficult to recognise it when you hear it played back. A good way to root out faults is by means of mutual assessment of instruction by other instructors. See p. 61.

If you are prone to run your words and sentences together too much, try making yourself pause after each sentence for a good two seconds, and for a second after any important word. Spacing speech out requires practice, which can best be done in private. Do not ever be afraid to pause if you get tangled up in your words. A deliberate pause passes unnoticed and produces a little expectancy, but a series of 'ers' or 'ums' to fill in time advertises that you are stuck for words.

Keep your voice up at the end of sentences, as there is a danger of tailing off sentences into a mumble. *You* may think you are doing well, but the real judge is the man in the far corner.

Eyes. Look at your class, let your gaze travel round the class from time to time, but it is useful to have a point back-stage centre a few feet above the heads of your class which will serve as a base from which to operate and return. By this means you can make each man in the class feel that you are speaking to him individually, and you have the whole class fairly well covered. There is real power in the human eye, so make good use of it. Avoid delivering a lecture to the vault of heaven or to the window at the side of the class, or to the blackboard.

Mannerisms. Avoid doing anything which will distract the class from what you are saying or demonstrating. Very few

instructors are free from mannerisms, but the particular way a man stands or moves about or gesticulates does not become a matter of any great importance unless it distracts the attention of the class.

Mannerisms are often nervous habits, such as throwing up a piece of chalk a few inches and catching it, tapping the side of leg with the pointer, or fidgeting with something on the bench. Nervous verbal habits are also distracting. A common mannerism I have noticed in some Service instructors is to punctuate practically every remark they make by barking in a challenging way the query 'Right?' followed by a stern gaze over the class as much as to say, 'Disagree at your peril.' Very few men under instruction of this sort feel it worth while to shout out 'Wrong' or 'I am not following you.' It is a good idea to find out at all stages whether or not the class is with you, but working the query 'Right?' to death defeats its own object. Better methods are suggested in the section on questioning (Chapter V). There are other verbal bad habits, that are used over and over again as a sort of padding. They become outworn tags that have no particular meaning for the class and when let loose continuously can have the same effect as a sleeping-draught. Some students have been known to keep themselves awake by maintaining a score of the number of times a favourite tag is used, and running a sweepstake on the result.

Stance. Unless you are a good actor, and know all the tricks of standing and gesticulating, the best advice is to stand easily on both feet, without being rigid or sloppy. Do not sit (unless conducting an informal discussion), lean or slouch. If you find your hands wanting to fidget, put one behind your back and let the other hang by your side.

Your own appearance can be a distraction if your dress is very untidy, or too flashy, or if you sorely need a haircut. Instructors are often very critical in judging their students,

but in their complacency they do not always realise that students apply a far severer and stricter standard in judging their instructors.

Attitude. Finally in this catalogue of virtues we have to consider the attitude of the instructor to his class. The establishment of a proper relationship between instructor and class is vitally important, and determines whether the process of learning is going to be a co-operative effort, an uneasy alliance, or a cold war. Army instructors are given excellent advice in a brief maxim: 'Your attitude must be *fair, firm* and *friendly*.' The instructor's fairness should spring from his own personal standards of honesty and integrity; his firmness from a sense of control and inner discipline in his own life, friendliness from the wisdom of unselfishness, and consideration for others. He must be sympathetic, and approachable. These are essential qualities in any well-integrated personality, and also sum up the essentials for good man-management.

These may seem formidable standards to achieve, but the instructor must set himself this high standard in dealing with his class, and then practise making the most of his gifts and personality.

The well-known lines of Burns,

'O wad some power the giftie gie us,
To see oursel's as ithers see us',

are particularly apt for the instructor. It would do a great many instructors good to be able to listen to the remarks of their men when they are discussing them after the instruction as they invariably do. This used to be put on as a 'playlet' in a course on Instructional Technique for Service Instructors, by putting over on a loudspeaker snatches of conversation that were supposed to have been picked up by a hidden microphone in the canteen after a period of instruction, and transmitted to the instructors on the course. The class then

discussed the rights, wrongs, and reasons surrounding these 'overheard' conversations.

Here are some examples that might be used on a training course for civilian instructors. B in each example is the fictitious instructor, but not the same one.

'That question of Taffy's fairly wiped the smile off his face.'

'Yes, didn't it? He did his best to talk himself out of it, and laugh it off, but you could see Taffy knew what he was talking about, and B was just bluffing.'

The moral here is never bluff. Know your stuff, and if you don't know all the answers (and very few people do), say you don't know but that you will find out for the next period. Then, of course, keep your promise. You will not lose face by being honest, but you will by bluffing.

'That story of B was a bit "offside" I thought.'

'Well, B doesn't put on any airs. He yarns away just as if we were all his pals in the local.'

'All the same, I don't see any point in his yarns.'

The point here is, do not throw away your position as an instructor by trying to curry favour with the class. Familiarity breeds loss of respect if not actual contempt, and certain classes of jokes or wisecracks are not appreciated by all members of a class.

'I didn't expect the works manager to come barging in and taking over like that, did you?'

'I suppose he has got to see what is going on and show us he is the boss, but B took a poor view of it I think.'

The relationship between the instructor and his class is sacred, and should not be interrupted. Instructors should never be disparaged in the presence of their class, nor behind their backs. Instructors in an establishment must be absolutely loyal to each other, and to those above them.

'B always seems to pick on Nobby to answer all the questions or to dance out in front.'

'He knows his old man and that's why he put Nobby on as a special turn when the Director came along.'

'Nobby is his blue-eyed boy all right.'

Every member of the class is entitled to a square deal. You must be fair to your class in every way. Favouritism, or any kind of unfairness, loses you respect. Do not try to shift the blame for any of your mistakes or weaknesses on to the class.

'We started B off again on his hobby-horse of how he won the war in Burma and serviced six aircraft a day.'

'I am glad he did go off at a tangent again as I hadn't looked up a thing about machine tools.'

This snatch of conversation shows the importance of being purposeful, and knowing your own mind. Do not follow red herrings and never allow slackness or slovenliness to pass unchecked.

'He knows his stuff all right and knows how to put it across, but he somehow gives me a pain in the neck.'

'He always tries to make you feel small.'

'I feel like a sausage going through a machine.'

Being firm and down on slackness, does not mean being remote and unapproachable or a petty dictator. With true insight into human nature, an instructor can gain the respect of the class in a friendly atmosphere, even though he has to pull men up for faults or slackness. Guard against any tendency on the part of the class to make a man look a fool, or to snigger at his bad performance. A timely comment from you will help, such as: 'You may think it is good fun watching Hamhand doing this but he can beat you all when it comes to working out the formulae.'

'B ought to have his act *The new man starting on the lathe* put on the television. It's the funniest thing I have seen.'

'He keeps such a straight face himself, and doesn't look a bit as though he is trying to be funny.'

A timely use of a little humour does a lot to sweeten relations between instructor and class. It releases any tension, and lubricates any points of friction that may exist. It can rally the class from a comatose state of semi-consciousness. But the joke must come off! The class has little sympathy for an instructor-comedian whose jokes fall flat. Even when well done, there can be too much of a good thing. 'Wrong way' demonstrations exaggerated to be funny should not be turned into a 'Crazy Gang' show more suited to a music-hall.

Beware of trying to earn or maintain a reputation for being the funny man. You will often secure the attention of the class, because it is waiting for the next wisecrack, but the instructional value of your lesson may suffer. Any humour should be brought in casually, as a part of the instructor's way of expressing himself. It is impossible to lay down any rules on this subject. Humour is not essential to good instruction. It is useful and is rather in the nature of a luxury. Be yourself and if humour does not come to you naturally, do not pursue it.

'Dusty Miller got it in the neck today, didn't he?'

'What was it B said to him? "If your brains, Miller, were to turn into gunpowder, they wouldn't blow your hat off." Poor old Dusty.'

Sarcasm sometimes gets a cheap laugh, but it is rarely worth it. If you make a man look a fool he will find it very hard to forgive you or forget it. Show a calm unruffled front to the class at all times. You achieve little or nothing by becoming exasperated, except to provide a little secret amusement for the class. *Do not nag.*

'What was it B wanted you for this morning?'

'He fixed up a time on Saturday morning to give me a run-through on starters and controllers.'

'On Saturday morning? A keen type, B.'

A man appreciates any sort of personal attention you can give him. A man is stimulated by the knowledge that you know his good points as well as his bad ones. Know your class and show that you know them all. For example:

'Here, Rogers, you are the expert on turning, come and set this lathe up for the job shown on the card.'

'Now, Bell, you came out top in wiring. I want you to be in charge of the party for re-wiring the lecture room. See me tomorrow at 10 a.m., about drawing the stores for the job.'

Take note, too, of the bottom third of the class. An extra class or two for the less bright will help you to find out just where they get stuck, and give them a chance to catch up with the others at their own speed without holding back the rest of the class.

'I have never yet been able to do anything right for B. Nothing anybody does is good enough for him.'

'I suppose he harps to every class he has, that it's the worst bunch of idiots he's ever come across.'

There is nothing to be gained from making a class feel that they are the worst lot that has ever taken the course. If things aren't going right, do something positive about it. The best plan is to take stock of yourself. A critical nagging attitude will get the backs of the class up, and good relations and proper co-operation will be impossible. It has been found that the best results are obtained by a good deal more praise than blame. Praise should be handed out with discrimination, and to particular individuals rather than *en bloc*. 'Well done,' or 'Well done, that man in the back row,' will not be nearly so effective as 'Well done, Smith.' It is, as we have seen,

important to learn the names of your class at once and address a man by his name.

Dealing out praise has a greater effectiveness when it can be given a little *crescendo* effect, such as,

(1st time), 'There is an improvement there, Taylor';

(2nd time), 'You are doing well now, Taylor, keep it up';

(3rd time), 'Taylor, that was a first-class piece of work.'

One often hears a seasoned instructor telling a class, 'This is dead easy,' 'There's nothing in it.' This may be so for the instructor but it may be far otherwise with the class, who become discouraged. It is better psychology to be quite honest and say, 'This is not at all easy and is going to be a severe test.' Such remarks serve as a challenge and bring out the best in the trainees.

It is a very sound piece of advice in dealing with people to put yourself in the position of the other fellow, and see through his eyes. If you can do this honestly, then your attitude will be free from any serious faults.

Do not imagine that manner and attitude, so lengthily discussed here, can be applied like a magic formula to every class or situation likely to be met with in instructing; allowances and modifications have to be made to suit each particular class and each subject. A class of young apprentices on an induction course needs different handling from that of senior technicians learning a new works process.

There is a great deal to be said for the common-sense middle way in dealing with the qualities of a good instructor and an attempt has been made in the following table to sum up these qualities on the basis of a well-known shaving-soap advertisement which advocates 'Not too much, not too little, but just right'.

One of the important aspects of the work of training instructors is to develop essential personal qualities. Knowledge of the subject is only one essential, but at least half

THE QUALITIES OF A GOOD INSTRUCTOR
(with apologies to the shaving-soap advertisement)

<i>An Instructor must</i>	<i>Not Too Little—</i>	<i>Not Too Much—</i>	<i>But Just Right</i>
Be purposeful.	No clear object. Wanders. No sense of time.	Enslaved to a plan. Enslaved by the clock and timetable. No flexibility.	Object clear. Keeps to the subject but deals with interesting points. Keeps an eye on the clock.
Know his subject.	(Skills) Poor demonstration. (Knowledge) Only a little ahead of class. (Techniques) Dare not leave the text-book.	Shows off. Dazzles the class with science. Becomes the talkative veteran.	Skilled demonstrations. Knows his stuff. Instruction backed by practical experience.
Be painstaking.	Lazy in preparation. Haphazard and muddled in methods.	Unadaptable. Too attentive to details. Pernickety.	Good preparation. Sense of balance and proportion.
Have dramatic sense.	Stodgy. Dull. Monotonous.	Spectacular performance but object lost in the spectacle. Too much variety.	Uses dramatic sense in proper place. Introduces variety.
Be enthusiastic	Apathetic. Uninterested.	Fanatical. Unbalanced in outlook. Boring.	Keen. Infects the class with his enthusiasm.
Have pleasing manners.	Fidgety, nervous, jarring voice. Awkward gestures.	Smooth, oily. Soapbox, smarmy. Slick.	At ease with class. Confident, pleasant voice. Natural.
Have control of class (attitude).	Has favourites. No control. Too familiar. Soft. 'This is a rotten job but someone has to do it.'	Undiscriminating. Domineering. Never relaxes. Sarcastic. 'The works are run for the benefit of instructors.'	Fair. Firm. Friendly. Respected—sets an example. Sees through the eyes of the class.

the time should be devoted to the improvement of an instructor's manner, attitude and outlook. In a very successful Service school for training junior instructors, more than 75 per cent. of the periods forming the course were spent in actual *practice* in instruction.

An instructor's performance in front of the class, including all the qualities just discussed, can best be assessed by one or more fellow-instructors. Mutual criticism should be a normal feature of a course for the training of instructors, but it is not easy to carry out in a works. Generally people do not find it easy to assess another person's ability to teach, but the task becomes more manageable if each quality you are assessing is considered separately and in isolation. A breakdown of the various points to look for in a lesson is made on the form shown in Fig. 6. The form is self-explanatory and is used for assessing the capabilities of a lecturer. The assessor has to fill in the form at the end of the period, but it is important not to attempt to fill the form in as the lecture proceeds. Preferably, this should be done on a separate piece of paper where specific evidence of weaknesses or good points can be noted.

Forms of this sort are generally accepted by instructors on a course as being a fair way of getting to know how they are faring. With the increasing use of the cinema, a 16-mm. film with a sound track, or a tape recording, could be made of some instruction which would form the basis of a small discussion of the points good and bad that such a film would bring to light. The film is the nearest we can get to seeing ourselves as others see us.

The form is introduced in this chapter because personal qualities such as the manner and attitude of instructors can be usefully assessed only by other instructors. We have not yet dealt with the Sections Class Interest, Participation of the Class, or Assimilation, although these points are fundamentally important in assessing a lesson. These matters will be dealt

LECTURE ASSESSMENT FORM

Did the Instructor:		Yes (+2)	On the whole Yes (+1)	50/50 (0)	On the whole No (-1)	No (-2)
Object	1. Keep the object in mind and go for it without digressing?					
Preparation	2. Know his subject? Plan the lesson well with good sequences, summaries, etc ?					
	3. Prepare good training aids and use them well?					
Presentation	4. Have a good manner? (Delivery, voice, gestures)					
	5. Have an attitude suitable for the subject and the class? (Fair, firm, friendly?)					

Did the class:

Reception	6. Show interest and keenness throughout the lesson?					
	7. As far as possible participate in the lesson and have to use their own brains?					
Assim.	8. Seem to assimilate the lesson up to the required standard?					

Subject

+TOTAL

-TOTAL

Lecturer

SUM TOTAL

Assessor

FIG. 6

with later. The form can be elaborated if required, but it is best kept as simple as possible. Any form of assessment has its weaknesses and limitations. It must not be regarded as an infallible way of grading instructors.

If three instructors used the form on an average instructor-colleague their markings would vary considerably—perhaps by as much as 4 or 5 points.

The following example is taken from the Army Handbook *Good Instruction*.

‘Suppose there are three critics, Smith, Smart and Stumble, who assess three instructors, Goodfellow, Oddfellow and Dumbfellow. Smith is an average steady sensible chap, Smart is an excellent instructor and very critical of others, Stumble is a poor instructor who imagines everyone else to be far better than he. The results of their assessment might look something like this:

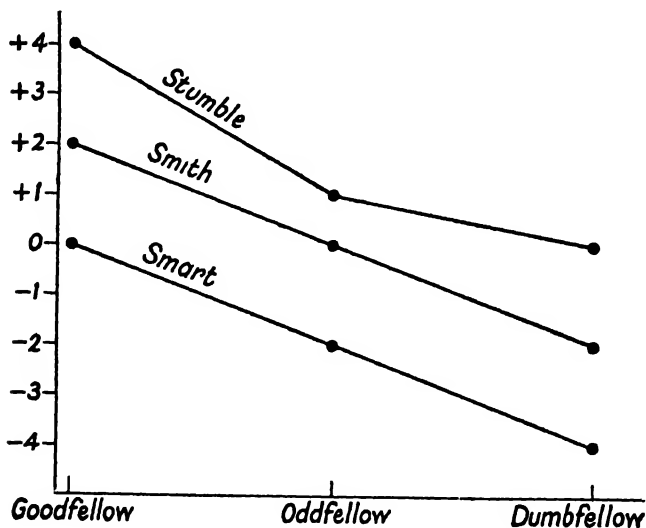


FIG. 7.

Each has his own standard, so that the *individual* marks are different, but each is a good enough critic to keep his standard constant, so that the *relative* marks are roughly the same.'

CHAPTER IV

The Class

THE LEARNING PROCESS

In this chapter technical instruction is considered not as a performance by the instructor, acting as a transmitting station, but as an activity of the class at the receiving end of the process. The instructor should stimulate a full contribution from the class, and obtain its co-operation in setting up an interchange of ideas and experience.

Nevertheless, no matter how skilled the instructor may be, learning is essentially the task of the learner, and can be accomplished only through the effort of the learner, who must be in a receptive frame of mind, and must have a desire to learn. If a man does not *want* to learn, you can use every known pedagogical artifice on him and he will learn nothing. A bad instructor working on a class which wants to learn will achieve far more than a good instructor with a class which does not want to learn. The instructor's responsibility is to see that all the motivating tactics available are used.

Interest is essential for attention, and attention is essential for learning and memory. Interest here does not mean simply a localised interest in a particular part of the syllabus, *or a day's work*; such a fragmentary interest may soon wane. The interest that *motivates* on a long course is something deeper and is based on fundamental emotions and desires. For example, interest of the sort that motivates apprentices is roused, encouraged and maintained by a number of basic

urges or desires. Some of these are listed below and against each is shown a suggested way of using this desire as a motivator.

<i>Basic Desire</i>	<i>How Made to Serve as a Motivator</i>
(1) Desire to qualify for higher grades or diplomas. Desire to earn more pay. Desire to 'get on' for the sake of a family or fiancée.	Show the purpose of the instruction, its importance to the trainee personally, and its relevance to examinations.
(2) Desire to 'make the grade' as a matter of self-esteem.	Progress-reporting, and by a proper use of rivalry and competition.
(3) Desire of the artisan to do a job well, and to take a pride in his work.	A proper distribution of praise and rewards.
(4) Desire for the satisfaction of intellectual achievement, which makes a worth-while subject intrinsically interesting.	Encourage the learners' curiosity and make use of the elements of realism and surprise. Use variety.
(5) Desire to express oneself and to take an active part in the activities of a group.	Keep the class as active as possible.
(6) Natural desire to be as comfortable as one reasonably can when undergoing instruction.	Give proper attention to the physical comfort of the class and class morale generally.

The motivating devices on the right require further consideration.

(1) *The learner should be made aware of the importance of the learning to himself and his future*

There should be a good purpose behind every piece of instruction given. The class is reasonable and if you reveal this purpose it will make the instruction more relevant to

the course, and personally applicable to the ambitions and aspirations of each member of the class.

The class will regard you as a person who is putting them on the right track and helping them to qualify. Here we see the importance of your preparation work in sorting out your subject-matter into *must* know, *should* know, and *could* know. A trainee in the midst of a hard course is right in not exerting himself over the things that he believes to be unnecessary frills. Your guidance here and explanation of the purpose of it all will be valuable.

Examinations and diplomas are useful motivators. Most apprentices and men on a course are fully aware of the importance of getting on in their trade or profession and each may prefer to keep this thought as a private spur for himself. Encourage men to look to their future, but do not exclude the other ways of motivating.

(2) Competition in the class motivates the learner

Rivalry is the soul of sport and it is inborn in us to be competitive creatures, not only in sport, but in thousands of other ways, from the way we dress to the way we swap stories. It has been estimated that nine-tenths of the world's work is done through rivalry, so it is an obvious though often neglected spur to use in instruction.

Wherever possible, use this competitive spirit in training, particularly when it can be successfully exploited in competitions between different groups. Suppose on a course on Works Safety a fire-drill has been worked out and it takes a group three and a half minutes to carry out the emergency action. A good instructor would work up a little competition between two rival groups and, by using a stop-watch, would set one team to improve on the performance of the other. Where time and productivity count for much, well-planned, healthy competition in training on actual processes can be very effectively used. Competitions between groups in first

aid, workmanship and handling materials should be carefully organised and run fairly. A few spectators will do no harm if the show is good. A little group rivalry in training can be used in ordinary class instruction. One way is to divide the class into two parts; get each half to prepare, say, a dozen questions, which they shoot at one another in turn; allot marks. In this way keenness and interest is developed through the competition of the opposing halves.

Stirring up one half of the class against the other, or one group against another, in friendly rivalry is much better than competitions between individuals, in which there is a danger of making the bright boys, who always come out on top, feel cocksure and the not-so-bright feel rather depressed. Rivalry is ruined if there is a big difference in performance between those competing. A football match where the score is 10-nil lacks interest and spirit. Vary the competitions so that everybody has a chance to do well at something.

Progress. Men under training are all, in a sense, competing, if not with each other, then with a standard of achievement. It is a basic desire in every man to want to succeed, or to 'make the grade'; used properly it can be a powerful motivating force. The trainee must have a feeling of progress and should not be allowed to slack off as soon as some particular training objective has been achieved.

When the class has reached one goal, set another so that there is a feeling of continuous effort and progress. Nothing is more deadly to a class than the feeling that they are marking time. (Sometimes this feeling is there when in actual fact the instructor is aware of definite progress.) The class must be made to feel that it is making progress, and it is the job of the instructor to encourage that feeling.

It may happen that a particular man's progress is slow and heavy going, giving him the feeling that he is never going to get through the course. This is a common trouble

and the line to take is to make a small mountain out of any molehill of progress, and to show it in the best possible light.

Use this wisdom when setting and marking tests. Arrange the test questions and marks so that the scores range from 55 per cent. to 85 per cent. instead of from the usual 15 per cent. to 45 per cent. These grade the class just as effectively and may give the class the encouragement it needs.

It is an excellent device to set a small test before a piece of instruction on a subject they all know *something* about, and then to set the same test after instruction. This invariably shows definite progress, and creates a sense of achievement in the class. The test paper on p. 91 was set at the beginning and at the end of a course for instructors which lasted a fortnight. The marks were compared, and in each case there was a marked improvement. This test paper was more an object-lesson than a serious test, but it served to give to the class a sense of achievement, and progress on its second setting.

A progress chart for the whole class, although it entails a little work, is a useful motivator.

A pictorial representation of the various obstacles to be surmounted, e.g. tests and jobs to be done, has more appeal than a dry-looking syllabus. A picture of general class progress is not very effective in motivating individuals and for this a system of individual progress reports is necessary. This topic is dealt with in Chapter VI.

It has been found that men always work better if they know the results of their efforts, even if those results are below their expectations, and this point is rather strikingly borne out in the two graphs plotted below, of two groups of students who were set to do mental multiplication. Group I was kept constantly informed, up to the first ten practices, of their results, and at each practice were encouraged to beat their previous score. The men in Group II were not told

their results at all for the first ten trials. After ten trials each the conditions were reversed. Group II was informed, and Group I was not, with the results depicted. (Fig. 8.)

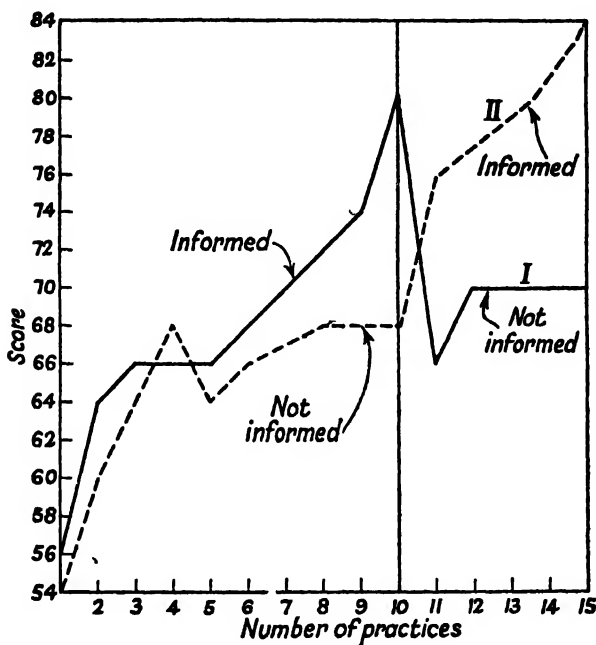


FIG. 8.

(3) Praise and rewards are better than blame and punishments

An effective, but rather heartless way of teaching an animal to perform tricks is to deprive it of a meal, and then use its desire for food as a motivator. Use a succulent morsel of food to entice it to do what you want, e.g. sit up or jump, and then instantly reward it with the piece of food. You here have a motivated animal and an effective system of rewards for good effort. Learning is rapid. The animal soon learns to

perform the trick, even when not hungry, provided there is some reward after each performance.

There are two recognised ways of getting a donkey along, the *stick* and the *carrot*. As we have already seen in Chapter III, you can induce men to travel along the path of learning far more satisfactorily by using a carrot.

Praise is more effective than blame, and rewards than punishments. The reason is fairly simple. Praise and rewards are pleasant motivators whereas blame and punishment have unpleasant associations and may make the victim dislike the instruction and the instructor. Most men want to please people they like and respect, hence it is clear that praise is only really effective if it comes from an instructor who is liked and respected by the class.

This is merely a general principle, but there are exceptions. You must know your man, as men are not alike. It may be right in some cases to give a man who is slack or undisciplined a dressing-down or a suitable punishment, making it clear by your manner that you have the man's interest at heart. A jolt may be what he needs, but be quite satisfied that you have tried, to the full, more friendly and persuasive methods without avail. The schoolmaster's reservation about using the stick is: 'When you punish a boy, have the boy's *end* in view.' Never be vindictive, and remember the principle firmly established by Gilbert and Sullivan of making the punishment fit the crime. Your attitude at all times must be Fair, Firm and Friendly.

(4) *Curiosity, realism, surprise, variety stimulate interest and therefore, motivate the class*

One of the most effective ways of stimulating a child's interest and commanding his attention is to hold something behind your back and say: 'Guess what I have.' Use this kind of appeal to man's natural curiosity when appropriate, in instruction. Keep the class guessing part of the time, for, although curiosity killed the cat, it helps to keep a class alive.

A puzzle is always a challenge, and a class should enjoy using its brains to solve a mystery.

This curiosity that arouses us and challenges us is at the bottom of our interest in the 'Whodunit' detective story, the fascination of conjuring tricks, quizzes, and 'Twenty Questions'.

The seasoned instructor, who holds up a piece of mechanism and then rattles off a word-perfect monologue in description of it, can come very near boring his class. A better approach would be: 'Here is a Snodgrass Pump. I want Smith to come out and turn the driving-wheel and the rest to watch carefully to see what happens. We shall puzzle it out step by step. Carry on, Smith. Do you all see the cam in the corner? What is it doing? Davis?' The topic of curiosity is bound up with the art of asking questions, which is dealt with more fully in Chapter V.

We all enjoy the satisfaction of solving a problem. Intellectual achievement gives pleasure and a difficult subject, if properly approached and handled, can become interesting for its own sake. A tricky point in electro-technics to a properly motivated class becomes like a mountain to a mountaineer—a challenge—and provides an equivalent satisfaction when conquered.

Realism and a sprinkling of surprises can be introduced into most pieces of instruction. Wherever possible, use the real thing to demonstrate instead of a drawing. Make your questions real and practical. Instead of: 'What is the formula for the minimum size of the supporting column in this structure?' try this: 'Measure up this material and let me know if you can make a supporting column from it for use on this job.'

Instead of: 'What are the rules of procedure for fault-finding on this set of machines?' try this: 'The machines are all out of order this morning. I want them in working order in fifteen minutes. Do the fault-finding systematically.'

If you are instructing in how to deal with any kind of emergency, make it as real as possible. Plan it and get an accomplice or two to help. If you stage an accident, get someone to be the victim and add a touch of realism with some red ink or lipstick.

(5) *Keep the class as active as possible*

A class undergoing technical instruction should be given every chance of *doing*. Passive reception will not turn out trained technicians. Recall the stock joke of father on Christmas Day insisting on showing his frustrated and exasperated small son how to work the model train and the signals. Father is a real menace, because the small boy wants to *do* it himself.

Trainees want to express themselves and to take part in what is going on. What is more, men often prefer their *own* way of going about learning a difficult topic. Within limits allow this latitude, but make sure that you are stimulating their natural curiosity and urge them to take part and do it themselves. This approach to an unexplored territory used by an intelligent and able instructor will prove of great value.

To a group of three or four men, who are ahead of the class, say: 'This is a new type of remote-control gear. I want you to inspect it, strip it if necessary, and find out all you can about it. I shall then ask one of you to explain how it works to the rest of the class.' Here we have possibilities for a little rivalry, curiosity and class activity.

Give trainees productive work to do, but they should not at first work with experienced employees on production work as this may lead to discouragement over comparisons in output.

(6a) *Class morale*

Class morale is the spirit and atmosphere of the class, and determines whether the class is one of cheerful co-operative

men with a bit of team-spirit about them or a collection of frustrated 'browed-off' unco-operative grouchers. Class morale depends on a great many factors, not the least of which of course is yourself, and your attitude to the class, as we have seen in Chapter III.

Your class will naturally tend to reflect the attitude and morale of the rest of the works or establishment. If the problems of human relationships have not been dealt with skilfully and honestly at all stages in the works, then morale in the class will suffer.

The overall object in training is to fit a man for his place in industry and to make him better and happier at his job. The basic needs of the ordinary man in a works have been summarised by Sir Roy Pinsent, Bt., in his pamphlet *Productivity in Industry* as follows:

To make a secure living.

To be treated as a man and respected as a person.

To have a voice in matters affecting him.

To know that he is wanted and belongs.

To know that the boss and the 'Top' really care what happens to him.

To have a chance to develop his highest skills and capacities.

To be assured of justice, openness, and absolute honesty at the hands of those who supervise and manage.

If we are to keep the larger object of training in view, we have to see that these needs are considered at the training stage. Where morale is low motivation will remain poor in spite of all the instructor's effort to improve it.

(6b) *Class comfort*

There are a number of simple physical conditions that affect morale and, therefore, motivation in a class.

A man is not well motivated if he is cold, or cannot see properly, or is squatting on an uncomfortable stool, or has

the light in his eyes, or if there is an uncomfortable background of noise going on in the next room or shop.

The more important points connected with class comfort are as follows:

The Lighting should be such that all the class can see well with no hard shadows across the paper on which the students are writing. Light coming from the left is the ideal. Inefficient lighting, particularly in the evening, can seriously hamper instruction. As far as possible, the shadowless type of fitting should be used in sufficient numbers and with proper spacing to give an intensity of lighting in lecture-rooms of 7 to 10 foot-candles at bench level, and an intensity somewhat higher in workshops, drawing offices and laboratories.

Temperature. This should be ideally round about 64° F. Make sure that none of the trainees is sitting in a bad draught, or has too much of the fire to himself. Ventilation is important, as stale air acts in close co-operation with a boring instructor in producing somnolence.

Size of Classes. The great disadvantage of a large class is that there is less scope for individual activity and attention. In learning a skill, it has already been emphasised that about 65 per cent. of the time should be spent in individual practice. This is impracticable with classes with more than about ten men. Experience has shown that an instructor teaching skills can give the necessary individual attention only to eight to ten men. Beyond this number instruction becomes more and more a one-way-traffic system and when the class is fifty or a hundred strong the sausage-machine stage in instructing is reached, with the class taking little or no *active* part except, we hope, using their brains. In brief, the smaller the class the greater the opportunities for class activity, the better the intake and assimilation. It is a general rule that the higher the grade under instruction the smaller the class should be as each individual has more to contribute

to the study group. Six to eight, however, seems to be necessary in order to establish a group structure and a group spirit.

Twenty-five trainees per instructor is a maximum for the lesson type of instruction and eight to twelve is a maximum for demonstrations that are followed by practice. Unfortunately the size of the class is frequently determined by the size and number of rooms, and the practical facilities available.

For lectures, films and exhibitions the numbers are limited only by the capacity of the room or hall.

Seating. The class should have plenty of room and should have comfortable seats with a back-rest, and a table for a forward rest.

Some technical training is carried out in the open: when this is the case, face the sun yourself rather than have your class suffer this discomfort. Sit the class down whenever convenient or plan the outdoor work so that unnecessary walking is eliminated. If the weather is bad, would the instruction be best indoors after all?

These are small points that affect the comfort of the class, but the good instructor will be on the look-out for them, as it is essential for the class to learn under the best conditions. Exercises to test or to develop the trainees' toughness or powers to stick at a hard job can be devised separately, and are important in some courses of training, but do not introduce these special activities into lessons which are designed for acquiring learning or skills.

CHAPTER V

Assimilation

In Chapter III an analogy was made between an instructor preparing a lesson and a chef preparing a banquet. The analogy can be stretched a little further, because instruction like food, is wasted unless taken in, digested, absorbed and used. Over-eating produces bad digestion. Cramming a

<i>Food</i>	A hungry man	eats	digests	absorbs	stores products in system ready for use
<i>Instruction</i>	A motivated man	attends	assimilates	remembers	stores in mind ready for use.

subject of study produces bad assimilation and generally bad examination results. Instruction to be of any value must be assimilated and remembered. There are several factors which affect the ease with which we assimilate and remember.

MEANING AND UNDERSTANDING

The instruction must have meaning and must be understood. A simple experiment will illustrate this. At the beginning of a period of instruction write on the blackboard a sentence of, say, six syllables:

‘The boy ran across the road’;

then tell the class you want to try a little experiment, but do

not disclose what it is. Invite the class to read the sentence three times, and then rub it off. Immediately write six nonsense syllables, for example, yac deb ron sur zad pef; ask the class to read them three times and make no other comment; rub the syllables off and carry on normal instruction.

At the end of the period, ask the class to write down first the sentence and then the nonsense syllables. All will be able to recall the sentence—few if any the nonsense syllables, although equal attention was given to each.

INTEREST AND ATTENTION

These have been discussed in Chapter VI. We cannot satisfactorily remember anything unless we attend to it, and the deeper our interest, the more concentrated and effective is our attention. There is no very clear evidence for a faculty of memory, there are only *persons remembering*.

DEPTH OF IMPRESSION

Memory is closely co-related with the vividness or depth of the impression made by the instruction. Memory in this respect resembles the impression made at a recording of a gramophone disc; a faint impression gives poor reproduction and is easily obliterated. Hence the importance of making instruction as impressive and as vivid as possible, using the elements of surprise, curiosity, realism, class activity, and competition as discussed in Chapter IV.

ASSOCIATION OF IDEAS

Memory is strongly aided by association of ideas. It is often fairly easy, after an interesting and rambling chat round a fireside or bar with some friends, to stop the conversation and rapidly trace back to its source the trend of the talking. This is made possible because, one thought led to another, and the various topics were connected by an association of ideas. Ideas appear to be linked together in

the mind, and whole groups of ideas are quite often recalled in association together. For the instructor the significance of this is that material for instruction should be linked with previous knowledge and presented in a sequence that leads naturally from one idea to another. An important point can even be associated with a funny story, as a story is not readily forgotten and helps to recall the point by association.

The boy scouts have a test of observation and memory, known as Kim's Game. Twenty-five assorted articles selected as random are placed on a table, the boy is allowed one minute to look at them, and must then write down all the articles he can remember. This is more difficult than it sounds, especially for those who do not have a good 'visual memory'. Some will find it helpful to make up a simple story bringing in each object to give some sort of meaning to the assortment. A man lights his *pipe* with a *match*, picks up his *purse* containing a *half-crown*, opens his door with a *key*, trips over his *bootlace* going down the step, takes a bus and buys a *ticket*, buys a *carnation* for his button-hole, fixes it with a *pin*, looks at himself in a *small mirror*, *combs* his hair, then meets his girl friend, who has a *green necklace*, and a small dog with a *collar*, and so on, until all the articles have been included. Such a story even though fantastic, has some sort of meaning, and forms associations that aid the memory.

FREQUENCY OF REPETITION

There are two ways of getting a nail into a hard block of wood. Either one hard, sharp, impressive blow, or a large number of small taps. Often topics of learning require a number of repetitions before assimilation and memory can be established.

TIME

This fortunately makes us forget; fortunately, because life would be quite unbearable if we were doomed to remember

everything we see, think, do, or say. We should be truly thankful for our forgetfulness. Good memory is often a matter of judiciously forgetting unimportant things.

FREQUENCY OF RECALL

Memory is helped by frequent opportunity for recall. I learn a telephone number today, but if I do not have to use it for a week I shall certainly forget it (unless it happens to be 1066, in which case it becomes associated with the only 'memorable' date in British History). If however I have to use it every day, I shall be able to recall it for several weeks or months.

Here is a summary of the factors affecting memory.

<i>Factor</i>	<i>How it affects Memory</i>	<i>Notes for Instructor</i>
Meaning and understanding	Memory very slight without these.	Make meaning clear, use simple words.
Interest and attention	Memory negligible without these.	Motivate the class. Inattention the instructor's sin.
Depth of impression	Memory proportional to impression.	Be impressive, use surprise, curiosity, etc. Chap. IV.
Association	Memory aided by association of ideas.	Good sequence, logical development. Humour, surprise.
Repetition	A piece of learning often has to be 'hammered' home.	Especially applicable to disconnected facts (Sweat and Test).
Time	Memory fades with time.	Regular and systematic revision.
Frequency of recall	Recall strengthens memory.	Class should 'give back' from time to time.

While on the topic of memory, it is worth noting that facts and figures are in themselves difficult to remember and, unless of vital importance to a man on his job, should be relegated to the *could know* part of the instruction. Dimensions of parts of machines and the size, pitch and core diameter of various screw-threads are far more readily looked up than remembered. Time is more wisely spent in making sure that general principles are known.

There are of course in all branches of technology many facts and figures which must be carried in the head and the learning of such facts is best done by a process known as 'sweat and test': the sweat indicates that the man is well motivated and makes a real effort; the 'test' part confirms the learning and provides opportunity for recall, giving back followed by more repetition. These together ensure assimilation.

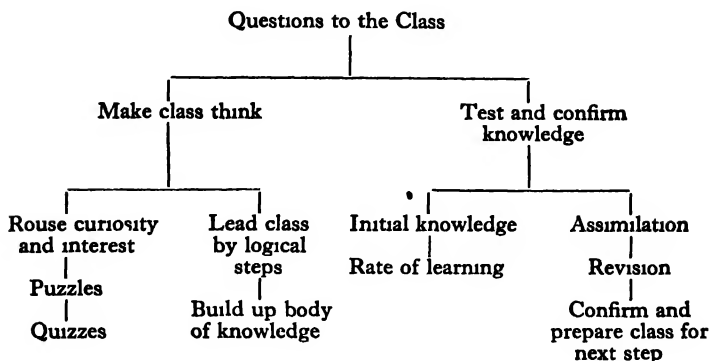
REPETITION, VARIATION, INSIGHT

We have all experienced the sudden flash of insight that comes when we ponder over and grapple with a particularly difficult problem. Instructors are generally familiar with the change on a trainee's face from a look of bewilderment to one of triumph when in a flash of inspiration the 'penny drops', as the process is sometimes colloquially called. Whenever there is difficulty in getting the class to see a complicated point, insight is assisted by repeating the reasoning with some variations or by a new approach.

Class activity assists assimilation. Points that have been worked out by a class make a deeper mental impression and are more readily assimilated and remembered than points that have been spoonfed to the class. The simplest, and perhaps the most effective way, of getting a class or individuals to work things out for themselves is by means of *questions and answers*.

QUESTIONS AND ANSWERS

Questions are asked by the instructor to make the class think or to test knowledge and assimilation.



Here are some examples of questions:

To arouse interest.

What is the horse-power of the engines of the s.s. *Queen Mary*?
 . . . a Comet aircraft?

To build up step by step some principle, question-and-answer might proceed thus :

Q. In this circuit (for the megger), suppose I make x , the unknown resistance, zero. How will this affect the current in the coil *B*? . . . pause . . . *Mr. Smith*.

A. It will be large compared with that in coil *A*.

Q. What will happen to the pointer on the instrument? . . . *Mr. Jones*.

A. It will swing to the right.

Q. Now suppose I make x several million ohms. How will this affect the current in coil *B*? . . . *Mr. Simpson*.

A. The current in *B* will be small compared with the current in *A*.

Q. What will happen to the pointer now? . . . *Mr. Baker*.

A. It will swing to the left.

Q. How can we use these ideas to make up an instrument to measure very high resistances? . . . *Mr. Green.*

Thus the class takes part in working it out for themselves, step by step, in a logical order.

Here is a 'wrong way' demonstration playlet on questions and answers.

Subject—Elementary Marine Engineering.

Q. What must ships have to make them go? . . . *Rogers.*

A. A captain.

Q. Certainly. What do you say, *Snelgrove*?

A. An engineer.

Q. Quite true, but what actually makes the ship go? . . . *Taylor.*

A. Engines.

Q. Yes, quite so, but the engines are of no use without something else. What is the something else? . . . *Edwards.*

A. Coal or oil.

Q. Correct, but it was not quite what I wanted. Let me try another approach. What is it which goes round and round at the stern of a ship? . . . *Roberts.*

Roberts having lost interest rises to the occasion and replies:

A. The log-line.

Q. You are all very stupid. They are large beautifully lined things beginning with S.

A. Chorus: *Sharks!* ! ! !

I'll have to tell *you*. Screws, commonly known as propellers, and we are going to study ships' screws this morning.

There was no trace of reasoning or class activity used in producing these answers. The instructor was merely .

playing a very dull guessing-game, and got what he deserved.

Questions to test knowledge, rate of learning, or state of assimilation are generally ordinary straightforward questions, e.g.:

What tests must be carried out on completion of any electrical installation?

What is the current-carrying capacity of a 19/064 cable?

Some questions combine a test of knowledge with a stimulus to interest and thought, e.g.:

How would you adjust the cam which operates the fuel pump, in order to make this engine run in a reverse direction?

There are several points to observe in putting questions to a class.

(1) *Name last.* Put the question first to the class, letting your eye rove over the whole class. Pause for a few seconds, then name the person you wish to answer it. This encourages everyone to listen and think out an answer in anticipation of being asked.

(2) *Spread.* Invitations to answer questions should be spread evenly throughout the class. They should not be restricted to a few bright members of the class or to the dull elements. Let there be no obvious system, such as going round the class, as this defeats the object of (1). It is sometimes helpful to tick names on the seating plan (Chapter III, p. 47) to ensure that questions are spread evenly and fairly.

(3) *Phrase carefully.* The meaning must be quite clear, and expressed in simple language; not 'What are the consequences of forcefully elevating the small spherical projection?' but 'What happens when the small knob is pushed up?'

(4) *Wrong answers.* Wrong answers are valuable in that they very often indicate weaknesses in your instruction. Use wrong answers to clear up hazy points and in planning revision.

(5) *Steps.* Step-by-step questions should be such that there are no big jumps from one piece of reasoning to the next.

(6) *Answer must be heard.* It is a good plan to repeat answers so as to make sure that the whole class has heard.

AVOID

(1) *Questions that have an obvious answer.* They waste time and stimulate no thought.

e.g. 'What is a starter used for?'

Echo questions come in this class. These are questions that have as an answer, an echo of your previous remark, e.g. 'When I push the lever forward, the pin engages the low gear wheel. What happens when I push the lever forward? . . . *Thomas.*' This is sometimes more often used to find out whether or not a man is asleep. It is a dodge that may have its uses in a nursery class in providing class activity at a low level but it should not be allowed out of the nursery class.

(2) *Questions which have several equally good answers,* and the class can give the answer you want only by guessing, e.g. 'What should all lorry drivers carry with them?' The answer might be Licence, Mate, Spare Wheel, Petrol, Works Order.

(3) *Questions that call for Yes or No as an answer.* These are banned because a trainee has an even chance of guessing the right answer.

The same applies to questions that have only two possible answers, e.g. 'Does the magnet increase the current or decrease it . . . *Williams?*'

(4) *Trick questions,* e.g. 'How many cylinders has a 4-stroke engine . . . *Bell?*' Riddles and catches, unless really amusing, irritate the class and achieve nothing.

(5) *Questions to which the class cannot be expected to give an answer,* e.g. a formula the class has not met before.

(6) *Questions which are a test of powers of expression,* e.g.

'How do you wind an armature . . . *Fairfield?*', or even worse, but in the same category, 'How do you keep your balance on a bicycle . . . *Hayter?*' Professors of dynamics are not quite clear on this last point, but riding a bicycle is easy enough to demonstrate.

You cannot test a man's *skill* by means of questions; you test a man's knowledge of a practical job far better by getting him to *do* it, than by asking him to tell you how he would do it.

Questions are suitable only for testing knowledge. It may occasionally be necessary to ask a man how he does something. If so, let him explain in his own way, and even if you get a very muddled answer, do not assume that the man does not know how to do it.

(7) *General questions* that are not definite and *to the point*: e.g. 'Do you see what I mean?' It is better to use test questions at intervals to make sure that the class is with you.

Don't ask questions for the sake of asking them.

Reference has already been made on page 52 to the bad habit some instructors develop of enquiring without much purpose, 'Right?' every few seconds.

Give due credit for good answers, even though they were not exactly what you wanted. A word of praise to the less-bright trainees does much to build confidence.

As a general rule, avoid putting questions to a man who is busy practising or demonstrating. If you want to make a point put a question to the rest of the class, or stop the man on the job before you ask him. He can then give you his undivided attention.

QUESTIONS BY THE CLASS

The class should be given opportunities to ask you questions. It is important not to discourage the class from asking questions by such damping comments as 'I can't

understand why people ask that silly question,' or 'You have clearly not been paying attention or you would know the answer to that one.' Such an attitude will put off many good questioners.

Questions by the class which anticipate later work could be written down in the instructor's note-book and taken up at the appropriate time.

Welcome and encourage questions. Frequently the class will remind you of a good point by a question. Thank them for it, e.g. 'Collins has raised a good point, he asks, etc. . . .' 'Can anyone give the answer? Can you . . . Steele?' When you receive the correct answer from the class confirm it as correct and repeat it so that you are certain all have heard it. If you do not know the answer yourself, say so, and promise to find out. But remember to find out.

SKILLS

So far we have dealt only with the assimilation of *knowledge*, but a great deal of technical training is concerned with the imparting of skills and techniques.

A skill is acquired through a kind of muscular memory. After we have successfully carried out a series of intricate operations, our muscles seem to remember how to do it and, even after a lapse of some weeks, we find we still have a fair amount of that skill. This skill-memory is much more durable than our memory for facts. Indeed, once we have learnt how to ride a bicycle, or to swim, or ride a horse, we never forget. The skill is not actually stored in our muscles but becomes a pattern in our mind and nervous system.

Signing your name, for example, might be regarded as the result of a well-trained set of wrist and finger muscles, but if you attempt to sign your name in the air with your big toe, you will find yourself going over exactly the same form that your pen makes. The skill is part of a mental pattern.

Although this skill-memory is more retentive than ordinary mind-memory, it nevertheless does decrease with time, but a few trials will soon restore the former standard.

Here are a few simple points about skill-memory. Learn the skill correctly the first time. If a faulty or awkward movement is acquired at an early stage, it becomes very difficult to get rid of the fault later. Cricketers, boxers, golfers, field and track athletes know this very well.

Expert demonstration is essential right from the start, and the object should be accuracy and correctness first and then speed.

As in mind-memory, skills need time to be assimilated. Our tennis or skating will not be improved if we play *intensively* for months on end; staleness sets in and we reach a stage when there is no improvement. Several weeks or even months of rest are often the best thing for some athletic skills. It has even been said that we learn to skate in summer and swim in winter. This is simply a paradoxical way of saying that the muscular skills we acquire in summer may be assimilated thoroughly in the winter ready for use the next summer.

MEMORY AIDS

Learning based on fundamental principles and logical reasoning which is understood, is far more valuable and easily recalled than learning acquired by rule-of-thumb methods, including memory rhymes or mnemonics, which can so easily be forgotten or distorted. Rhymes and mnemonics are however useful when no logical principle is concerned, e.g. 'Thirty days hath September, etc.' The colours of the spectrum are contained in VIBGYOR. Sailors use memory tricks to remember their navigation; the topmarks of middleground buoys are remembered by 'To sea for diamonds and home for Bass'. An example of a pleasant association of ideas.

As a general rule, discourage learning like a parrot, and certainly avoid teaching like one. Rote learning can be disastrous,

‘For though they wrote it all by rote,
They did not write it right.’

Give every opportunity you can to trainees to put into practice, and express, what they have learned. Expression deepens the impression.

Schoolboy ‘howlers’ are the result of bad assimilation. A boy, after several lessons on General Science and Geography, was asked in a test: ‘What causes the tides?’ The reply given was: ‘The tides are caused by the rays of the moon striking the surface of the sea at an angle of $23\frac{1}{2}^{\circ}$ Fahrenheit!’ A good example of bad assimilation.

ENDING A PERIOD

The ending of the period of instruction is a matter of some importance, and gives the instructor an opportunity to give any finishing touches to the processes of assimilation and to test how far the object of the instruction has been achieved. The instructor, when about five minutes from the end of the period, might ask, ‘Any questions?’ Then ask the class some. Finally, give a summary which should be a brief account of the main points of the *must know* part of the instruction.

If the period has been devoted to learning a skill, then the ending might be along the following lines:

‘Any questions?’; final practice of essential skills; instructor comments on progress made in relation to what has to come next.

Assimilation cannot adequately be dealt with in one chapter, as it enters into every aspect of instruction. Testing and progress-reporting play a part in assimilation, and they are considered in the next chapter.

CHAPTER VI

Testing, Examinations, and Progress Reporting

Tests and examinations play an important part in any course of instruction; they can be used to help the class and to provide valuable information to the instructor.

For the class, a test can: (a) Provide a goal to be reached, and promote a sense of achievement. (b) Confirm what has been learnt and so aid assimilation. (c) Motivate the class by competition, as each trainee wants to do well and excel. (d) Enable each trainee to know how he is faring on the course and what his particular weaknesses are. (See Chapter IV.)

For the instructor, a test can: (a) Make clear what the class knows at the start, if set at the beginning of the course. (b) Grade the class by ability. (c) Measure progress and how much of the teaching has been assimilated, and so reveal weaknesses in the instruction. (d) Show how much revision is necessary and whether the object of the instruction or the course has been achieved.

The instructor should not use tests merely as a means of stimulating a lazy class, and although such tests may occasionally be necessary, it is more valuable to design tests to give confidence and encouragement. This does not mean that tests have to be easy. Preliminary tests should in fact be a little harder and more exacting than the final test for much the same reason that an athlete training for the 440 yds. will run an occasional 600 yds.

A good system of testing and reporting is one which gives to the serious student a sense of progress and achievement. This can be done by testing at the beginning, at intervals throughout the course, and at the end of the course.

As a general rule tests should be set a few days or a week or two after the instruction. If you test a class immediately after a piece of work, there is a tendency for assimilation to be arrested because a student may rely on a short-term memory and forget everything the test covered as soon as it is over. As we have seen earlier, good assimilation is tested by good retention. After a test has been completed the instructor should not encourage the attitude that the test was the end of that part of the work; he should make it quite clear that each test is a means of consolidating a position gained, ready for an attack on the next part of the syllabus, which will lead up to the next test, and so on.

It is important to give trainees the results of tests, and to hold a post-mortem on the results, within a day or two of the test. The longer the interval between test and the results, the more remote the test becomes in the minds of the trainees and the good effects of timely praise or censure rapidly diminish. Post-mortems on tests are excellent for teaching and confirming what has been learnt. We saw in Chapter IV, p. 68, that the whole attitude of a class towards its work can be influenced by the way the class is tested and kept informed of results.

TESTING SKILLS AND TECHNIQUES

In testing a skill or a technique, make the test a practical one. You test a man's skill if you have him in the shop and say: 'Join these two cables.' You probably test his powers of expression if you set a written question or ask him orally: 'Describe how you would join two 19/064 electric cables.'

A man may get good marks for his oral or written question, but make a poor showing if confronted with the job, and vice versa.

In general avoid tests that require the essay type of answer. This can be done for example by the Alternative Answer Test which has several advantages. It eliminates writing and is therefore not concerned with testing a candidate's powers of expression. It takes only a few minutes to complete, and is rapidly and easily marked. Results are independent of the marker.

Here is an example of a test (not to be taken too seriously) which might be used at the beginning and again at the end of a course for instructors to illustrate (1) the use of an alternative-answer-type test, (2) the use of a test to find out what the class knows at the start, and (3) the use of a test to produce a feeling of progress and achievement.

A class of twenty-five can be tested in ten minutes, the papers can be marked quite objectively by means of a grid, and the results given out in about half an hour of the close of the test.

INSTRUCTIONS

Time allowed: 10 minutes

Read the following carefully

1. All answers should be made on the separate answer sheet given to you, so do not write anything on this test paper.
2. The answer to each question is to be given by putting a ring round one of the letters A, B, C, D, opposite whichever statement you consider the best.
3. If you do not know the answer to a question, put a dash against the number of the question.
4. Work as quickly as you can.
5. As soon as the examiner says 'stop writing' put your pencil down on your desk.

TEST

1. A good instructor when lecturing a large class should:
 - A. Walk about continuously.

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- B. Stand at the back of the class.
 - C. Stand in front of the class and move about occasionally.
 - D. Make himself comfortable by sitting down.
2. A good instructor should:
- A. Speak as loudly as he can.
 - B. Speak in his natural voice with plenty of variations in speed and tone.
 - C. Speak very slowly and avoid variations in tone.
 - D. Try to imitate the style of the best public speaker he has heard.
3. You have an odd half-hour with your class. So you would:
- A. Tell the class to lose itself quietly so as not to disturb the rest of the establishment.
 - B. Set the class to read their notes.
 - C. Put a good apprentice in charge and relax in the staff-room.
 - D. Run a brains trust or similar game on the work of the past few weeks.
4. Demonstration models should:
- A. Not be used at all in the class-room.
 - B. Be displayed prominently throughout the course.
 - C. Kept out of sight till wanted for actual use.
 - D. Shown only at the very end of the course.
5. An instructor when instructing should:
- A. Have his lecture written out in full and use it.
 - B. Use a good text-book as his lecture note-book.
 - C. Use a few headings and sub-headings.
 - D. Use no notes at all.
6. An instructor should tell a funny story:
- A. Whenever he can think of one.
 - B. When appropriate to the occasion.
 - C. Not at all as it is out of place and interrupts instruction.
 - D. Whenever the class looks like going to sleep.

7. New technical words should:

- A. Not be explained at all, as the meaning only comes with use.
- B. Be used first and explained later.
- C. Be written on the blackboard first, explained and then used.
- D. Be explained and not used for a few days.

8. Notes of each lesson are most effective when:

- A. Dictated to the class by the instructor.
- B. Taken down during the lecture uncontrolled by the lecturer.
- C. Copied out from the text-book as convenient.
- D. Taken from the blackboard as headings and main points at the end of each natural division in the lesson.

9. We obtain most of our experience through our:

- A. Ears.
- B. Eyes.
- C. Hands.
- D. Nose.

10. When teaching a class the instructor should:

- A. Confine himself to lecturing.
- B. Appeal to as many senses as he can.
- C. Lecture most of the time and appeal to the senses of sight and feeling sparingly.
- D. Use the sense of sight at the end of the lesson.

11. In an initial piece of instruction on the lathe you would:

- A. Give the class a good lecture using a diagram of a lathe.
- B. Give the class what they ought to know about it first, and keep the actual lathe out of sight till the end.
- C. Let the trainees see and handle the lathe under your supervision during the first period of the course.
- D. Arrange for the class to pick up on their own what they can about turning for a few days and then come to the class for instruction.

12. Questions should be:
- A. Asked mainly of the bright trainees.
 - B. Asked mainly of the dull trainees.
 - C. Asked mainly of the trainees who are too nervous to ask questions.
 - D. Spread evenly among the class.
13. Questions should be asked chiefly:
- A. To keep the class awake.
 - B. To catch the lazy ones.
 - C. To obtain the active participation of the class.
 - D. To encourage the best ones.
14. A small class of men under instruction should be:
- A. Encouraged to ask questions.
 - B. Told to ask questions individually after the lesson is over.
 - C. Told to write questions down and pass them up.
 - D. Told not to ask questions but to listen carefully.
15. When asking a question the instructor should:
- A. Address the question to the whole class and allow the man who knows to answer up smartly on his own initiative.
 - B. Address the question to one man.
 - C. Address the question to the whole class, pause, and then select one man by name to answer.
 - D. Address the question to the whole class, pause, and give the answer himself to save time and avoid wrong answers.
16. If you are asked a question you do not know the answer to, you would:
- A. Skillfully turn the topic on to a point you know the answer to.
 - B. Say, 'I will deal with that point to-morrow.'
 - C. Say, 'I am sorry I do not know; but I will find out.'
 - D. Say, 'You ought to know that. Look it up for yourself and tell me to-morrow.'

17. In a class of twenty apprentices an examination showed the following results:

One man obtains 95 per cent.

Nine men obtain between 90 per cent. and 95 per cent.

Seven men obtain between 80 per cent. and 90 per cent.

Three men obtain between 70 per cent and 80 per cent.

What is a reasonable conclusion from these results:

- A. The class is a good one.
- B. The examination questions were too easy to test the class properly.
- C. The question paper had leaked out.
- D. The examinees have copied.

18. A class, 'A', of apprentices obtained an average mark of 58 per cent. on passing out. Another class, 'B', on a similar course and exam., six months later obtained an average of 52 per cent. What is your conclusion?

- A. Class A is better than class B.
- B. The examination was harder for B than for A.
- C. Class B was not as well trained as A.
- D. No conclusion is possible.

19. You ask to see a report on an apprentice, and his marks in five successive class tests are 46 per cent., 49 per cent., 52 per cent., 53 per cent. and 55 per cent. From this information what would you conclude?

- A. The apprentice has improved.
- B. He should have shown more improvement.
- C. From these marks no conclusion is possible.
- D. The general standard must be low.

20. The best time of day for a difficult piece of technical instruction is:

- A. In the evening after a football match.
- B. The first period of the morning.
- C. End of the morning.
- D. Just before tea.

21. You want to get the best out of a good class of men on a 'National Certificate' course. You would:

- A. Maintain and publish class and individual 'Progress Reports'.
- B. Tell the whole class from time to time that they are much poorer than the last lot.
- C. Tell the whole class that they are much better than the last lot.
- D. 'Take it out of the class' in every possible way, to keep them up to the mark.

22. You are responsible for making up classes. Which policy would you adopt?

- A. Change men from one batch to another as frequently as possible to prevent the formation of 'cliques'.
- B. Change men as little as possible to stabilise groups.
- C. Change a few best types frequently.
- D. Change a few worst types frequently.

23. During a course for men selected for training prior to promotion to a higher grade, the object of a personal interview should be:

- A. To keep the man in suspense till the end of the course.
- B. Let him know where he stands and what his chances are.
- C. To tell him in general terms that he must 'get down to it' or 'pull up his socks'.
- D. To let him feel he is bound to make the grade no matter what he is actually like.

24. You have an apprentice who has gone right off in his work on a course. You would:

- A. Call him for a personal interview and find out what is wrong.
- B. Ignore him and let things right themselves.
- C. Give him a severe reprimand and warning in the presence of the class.
- D. Get every instructor and foreman in the firm who deals with him to see that he does not slack.

25. You have been asked to give a course to a newly formed class of men. The *first* thing to do is:

- A. Study the subject hard.
- B. Find out what the men know.
- C. Find out what the object of the course is.
- D. Talk to some men who have already done the course.

26. You have a class of fifteen men sent to you from another branch of the firm for a special technical course. You would:

- A. Assume they know nothing and start from scratch.
- B. Assume they know what you think they ought to know.
- C. Hold a short test on the first day and find out.
- D. Find out what they know as you go along.

27. You have an industrial film illustrating a part of your course. You would:

- A. Keep it till the end of the course.
- B. Keep it for an odd morning or Friday afternoon.
- C. Put it on when the interest seems to be at a low ebb.
- D. Use it in a place that suits the programme of the course.

28. You have forty-five apprentices to be divided into three classes of fifteen each. They are all to be on the same course. You would:

- A. Divide them into classes alphabetically and tell the instructor to go the pace of the best in the class—the others will follow on.
- B. Divide them into classes to ensure a good mixture in each class and go the pace of the slowest. The best man can take it easy if the pace is too slow.
- C. Set a short test to grade the men and form three classes according to their ability to learn. Each class will then have men of about equal ability and lose the stimulus (if any) of the best men.
- D. Leave it to the office to decide, and not bother with such details as they are unimportant.

29. You have to plan a syllabus for a piece of technical instruction with practical skill as the main object. You would:

- A. Spend most of the time demonstrating as the practical skill will come when the men get on the job.
- B. Allot about 20 per cent. of the time to practical work, the rest of the time to explaining.
- C. Allot 50 per cent. of the time to practice.
- D. Allot more than 50 per cent. of the time to practice.

ANSWERS

- | | | | |
|--------|--------|--------|--------|
| 1. C. | 8. D. | 15. C. | 22. B |
| 2. B. | 9. B. | 16. C. | 23. B |
| 3. D. | 10. B. | 17. B. | 24. A |
| 4. C. | 11. C. | 18. D. | 25. C |
| 5. C. | 12. D. | 19. C. | 26. C. |
| 6. B. | 13. C. | 20. B. | 27. D. |
| 7. C. | 14. A. | 21. A. | 28. C. |
| 29. D. | | | |

Points to note in setting this type of test

There should be a large number of questions. Fifty questions is a satisfactory number in order to derive a fair score. Answer sheets can be provided, and candidates can indicate their selected answer with a ring thus:

- | | |
|-------|-------|
| 1. A. | 2. A. |
| B. | ⓑ. |
| ⓒ. | C. |
| D. | D. |

Each of the alternatives offered should be a reasonable and possible answer. Alternatives having obviously wrong or nonsensical answers should not be used. The position of the correct answer should be varied haphazardly.

In order to correct for the possibility that some of the right answers may have been good guesses, the actual number of correct answers scored has to be slightly reduced, in..

order to obtain a fair score. If a man gets n answers right and m answers wrong in the test given, it is reasonable to infer that out of the n he got right, that $m/3$ of these are probably attributable to lucky guesses.

How can one determine that a correct answer was a guess? If each answer can be answered in four ways, then the probability of a man guessing the right answer is 1 in 4, and of getting the wrong answer is 3 in 4. Thus, with a large number of questions, for every three wrong answers we would expect to find one good guess.

Thus in a test of fifty questions, if a candidate had

Total correct	31
Total incorrect	15
Not attempted	4 (ignore these)

his score would be $31 - (15/3) = 26$.

Thus, if there are N questions, with p choices in each, a man gets n right and m wrong.

His corrected score is $n - \frac{m}{p-1}$ out of N . (1).

If a candidate knows nothing about the subject and guesses all the time, he is likely to get N/p right, and $N - \frac{N}{p}$ wrong.

His score by substituting in formula (1) will be 0, which is what he deserves.

There are several other ways of avoiding a written test. The One Word Answer Test is one which merely calls for the missing word to be supplied, e.g.:

The usual limits of accuracy for mass-production grinding is . . . (0.0001").

For lathe work the cutting edge of the tool should be . . . (1/32 in.) below the centre of the work.

This test is only useful when testing lists of names, dates or sizes, etc. Care must be taken in setting this type of test, otherwise long answers or explanations that are not called for will be given.

The test must be practical, and in order not to waste time, everyone under test must be employed. The tests should be interesting, and closely connected with the actual work the men are likely to have to do later.

In an important practical test it is generally desirable to test each trainee in four or five different kinds of job. This could mean that for a class of twenty men about eighty or more sets of testing gear would be required. The County Fair type of test economises in sets of apparatus; everyone is kept busy and all apparatus is in full use. Divide the men into say, four batches and have four sets of jobs. Each batch has five minutes on a job after which each batch passes on to the next at a given signal.

Fig. 9 is an example taken from the Army booklet *Good Instruction*. The work can be judged by going round and making rapid notes on how each man tackles his job. In addition, each man can be asked to write down on a card in three or four words the key to the practical problem set, e.g. *Density of acid 1.122 at 67° F.* or *Distributor spring broken*. This assists marking but it should not become a test of expression.

Tests should be regarded as a part of training, or as a training aid, and not as a necessary interruption to be endured. A test is frequently of great importance in deciding a man's future and should be set by men of experience, having a full understanding of the principles of testing.

UNRELIABILITY OF MARKS

Many instructors, and indeed schoolmasters and education authorities, tend to regard marks with a certain reverence as if they possessed a kind of magic, whereas they are in fact

Examine greasy distributor and contact breaker with spring broken (5 minutes)



(b)

*What's wrong? (5 marks)
How would you get home? (10 marks)*

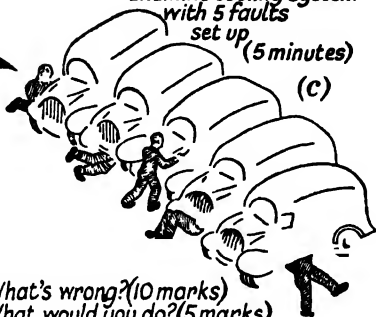


(c)

*Examine 5 tyre exhibits (5 mins.)
What's wrong with each? (5 marks)
What has caused it? (5 marks)
What would you do about it? (5 marks)*

*Total time: 20 minutes
Possible score: 55 marks*

Examine cooling system with 5 faults set up (5 minutes)



(c)

*What's wrong? (10 marks)
What would you do? (5 marks)*



(d)

From an assortment of tools write down which are needed for tracking a vehicle (10 marks - 5 mins.)

FIG. 9.

generally nothing more than a convenient means of giving a man a rank in his class. Rarely can marks give a correct idea of an absolute standard reached.

For example, a man who says that he scored 65 per cent. in an examination, conveys very little about his real worth in his class or the actual standard he has reached, unless we know a great deal more about the way the examination has been devised and standardised; the pass mark in this case

might have been 90 per cent. or 50 per cent; the examiner might have been harsh or benevolent; the student might have been bottom of his class with his 65 per cent. or he might have been top.

The most satisfactory function of examinations is to grade men in their order of merit and a good examination is one which succeeds in giving a good spread of marks which will make this grading possible.

With special care, however, standards can be fixed in specially devised examinations, so that the marking is objective and a pass mark represents a fair and fixed standard.

In testing used as a training aid, it is generally more effective and useful to measure a man's ability by that of the rest of the class. For example, if you know that a man is 9th out of 100, you have a good idea of his ability.

It is reasonable to assume that ability in a class of men under training will spread over the class so that there will be a few very bright men, a few very dull and a far more numerous middle group. This is roughly what is known as a normal distribution.

The following example will illustrate the advantage of using an examination to grade the members of the class as against imposing a fixed standard.

Students	Instructor I (<i>Strict</i>)		Instructor II (<i>Easy with Marks</i>)	
	<i>Marks</i>	<i>Grade</i>	<i>Marks</i>	<i>Grade</i>
Brown	8	10	10	10
Jones ..	6	9	9	9
Ingram ..	4	8	8	8
Hitch	4	8	8	8
Evans	3	6	6	6
Able ..	2	5	6	6
Dean	2	5	6	6
Cook ..	1	3	3	3
Field ..	0	1	2	2
Green	0	1	1	1

There was considerable difference in the marks obtained from different instructors, but the grading of the students is practically the same in each case.

STANNINE GRADING

The idea of giving each man a grade in his class has been developed into what has been called *Stannine* grading and can be used very effectively in class examinations to help the instructor to distinguish between real progress and apparent progress in a particular student.

A few points about normal distribution will help here. In a class of four students, if ability is distributed normally, one will be bright, one not very bright, and two average. In a class of, say, fourteen, we could have a five-point scale, which would give a distribution something like this:

1 very bright
3 bright
6 average
3 dull
1 very dull

With larger classes, it is convenient to use more points in the scale. With a class of one hundred, the nine-point scale or stannine grading can be used and the numbers normally falling in each grade will be as follows:

The top	3	grade	9	
next	7	„	8	
„	12	„	7	
„	18	„	6	The way in which the students
„	20	„	5	are distributed in the various
„	18	„	4	grades can be shown graphically.
„	12	„	3	The resulting curve (Fig. 10) is
„	7	„	2	called 'the curve of normal
„	3	„	1	distribution'.

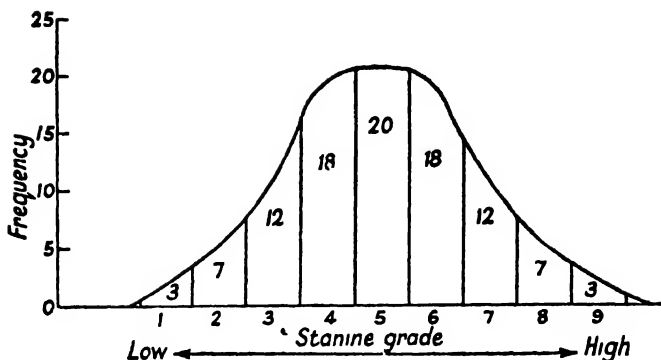


FIG. 10.

It will be noted that as we assumed one hundred students to be in the class the numbers falling in each grade can be regarded as percentages, and these percentages used for larger or smaller classes. Note that over 50 per cent. of the class will come in the grades 4, 5, 6 while 10 per cent. fall in classes 1, 2, or 8, 9. This should serve as a guide for a class of any number.

To turn a test score into stannine grades, write down the full range of the marks and then write down the number of students getting each score. Now divide into groups as near as possible to the numbers 3, 7, 12, 18, 20, 18, 12, 7, 3 as shown below.

The advantage of the stannine grading is that it makes a student conscious of his *place* in the class which is an important measure of his ability.

If his grades in successive tests are 4, 5, 5, 6, it is reasonable to infer that he is improving; if 8, 7, 7, 6 he is falling off. Raw marks may not reveal these trends.

It is true that this system does not show the progress of the class as a whole, but it can be supplemented by standardised tests from time to time to check that the class as a whole is

EXAMINATIONS AND PROGRESS REPORTING 105

<i>Score obtained</i>	<i>Number getting this score (frequency)</i>	<i>Total in Grade</i>	<i>Stannine Grade</i>
73	1	3	9
72	2		
71	0		
70	3	8	8
69	5		
68	3	11	7
67	4		
66	2		
65	2		
64	5	17	6
63	3		
62	5		
61	4		
60	4	21	5
59	8		
58	5		
57	4		
56	7	18	4
55	5		
54	6		
53	5	12	3
52	5		
51	2		
50	3	7	2
49	3		
48	1		
47	1	3	1
46	0		
45	2		

up to the mark—and at least equal to previous good classes—using the same standard tests.

It is important in setting a test to select questions that will test the full powers of all but the top two or three, and yet be within the ability range of all but the very bottom two or

three. This ensures a good distribution of scores. Examination mark lists often give more information about the skill of the examiner in his job than that of the examinee in his.

The following histograms of tests set to a class of twenty students will illustrate this point:

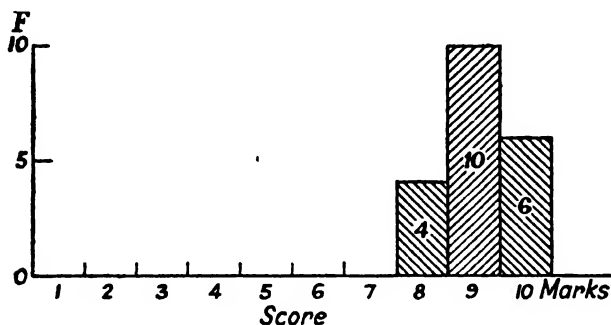


FIG. 11

This test was too easy in that it did not test all the class to their full capacity. Six students obtained full marks, half the class obtained nine marks, and four eight. The scoring range is only three marks and any attempt to grade the class would be of very doubtful value.

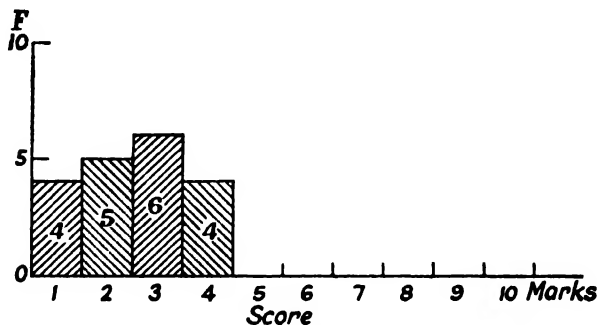


FIG. 12.

This test was too difficult and, although grading could be attempted, the result would be unreliable with such a small spread of marks.

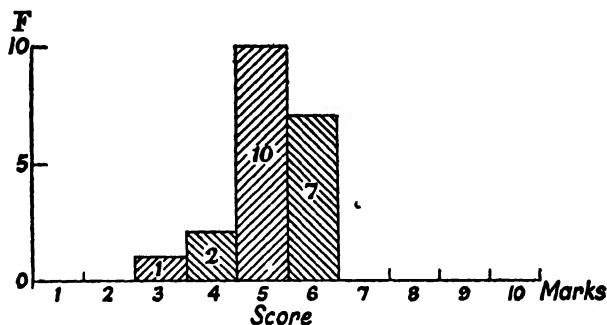


FIG. 13.

This result might be obtained when the test contained a mixture of questions, some of which were too easy and some too hard and beyond the capacity of anyone in the class. All but two or three dullards get marks between 5 and 6. No reliable grading is therefore possible.

Here is an example of a well-devised test:

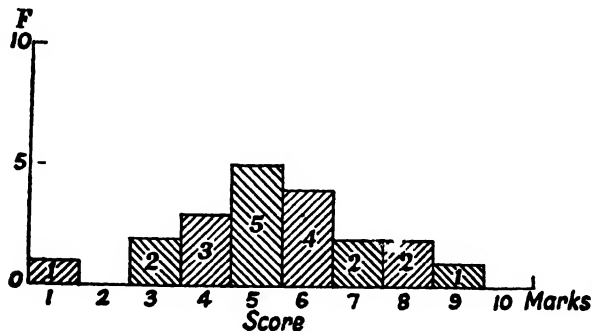


FIG. 14.

The score extends over the whole range of the marks available and the class can be rated with a measure of confidence. The distribution is very roughly a normal one, but a better approximation to the distribution in Fig. 10 could be expected with a class of one hundred. With a good test and a class of twenty-five or so it is possible to give a stannine grading.

PRACTICAL POINTS IN DEVISING, CONDUCTING AND MARKING TESTS

1. Good seating arrangements with candidates well spaced and no serious distractions.
2. Everything ready: paper, pencils, instruments, apparatus and instructions.
3. It is generally more satisfactory and easier for marking to set a large number of short-answer questions, rather than a few questions that require long answers.

In the alternative-answer type of test, the answer sheet can be gridded and a stencil cut with the correct answers written on it, so that marking is automatic and is independent of the personal judgment of the marker.

4. Questions should be clearly worded. Have a clear idea of the answer you expect for full marks when you set the question.
5. A test of skill must be practical. Test accuracy first, speed later.
6. Test knowledge, not power of expression.
7. Give the results to the class the next day if possible and use a post-mortem to teach or confirm.
8. Use a red pen or pencil for marking, as this helps the eye to pick up the marks more easily for totalling.
9. Be punctilious over the timing, starting and finishing, and indicate the passage of time at reasonable intervals. Allow

no talking or communication between candidates under test.

10. Decisions regarding a man's future should not be based on the results of tests alone but tests help to overcome the unfairness in promotion by seniority or by a personal opinion.

PROGRESS REPORTING AND SELECTING MEN

Simple satisfactory tests cannot be devised to test a man's will to work, or his integrity, or his ability to co-operate with others. These qualities have to be estimated by observation over a period of several weeks or months.

One of the ancillary functions of training is to provide a means of assessing a trainee's ability and aptitude for a particular job, so that a grading of men by ability becomes possible, and a selection of men for advancement, can be made with some confidence.

A full account of the methods of selecting and placing men is beyond the scope of this book, but instructors and supervisors of training should be acquainted with the general principles of the subject and should appreciate that the value of good training can be made nugatory by training the wrong man; the round peg in the square hole produces frustration, inefficiency, and unhappiness. He may work for half a lifetime under physical or psychological strain leading to conflict with fellow-workers, and breaches of discipline. In another type of work he might have been efficient and well adjusted.

It is important to find out by means of observation or a preliminary test before training what type of work a man can best do. If this cannot be done systematically, then early in a training course, men who are clearly unsuited to a particular type of work should be given a chance to change to a more suitable type.

Selection at all levels and at all stages must be made by a planned and systematic method and not left to blind chance or personal prejudice.

In many jobs, qualities of temperament and character, such as reliability, integrity, initiative and self-confidence, are more important than the technical skill involved. A job of skill and interest for one man may become for another, equally skilful, a matter of routine and repetition. Some skilled men can accept repetition cheerfully, but others of a different temperament become restless and bored.

The training officer may be confronted with three types of selection: 1. Recruiting and selecting new men from outside the works or company. 2. Selecting within the works for training or promotion. 3. Selecting for advancement on the results of a course of training.

In all three cases the problem has two main aspects:

- (1) What the job requires of the man.
- (2) What the man can best do with satisfaction to himself and to the firm.

1. *An analysis of the human qualities required* for success or failure in a particular job or type of work, is called Job Specification. Briefly this involves listing the physical, mental and social demands it will make on the trainee, e.g. Does the work require any special physical standards? good eyesight? manual skill? (are left-handed people at a disadvantage?) ability to perform rapid calculations? ability to co-operate with others? ability to supervise others? a sound judgment? What are the 'essential qualifications'? What are the 'disqualifications'? What are the unattractive limitations of the job?

An analysis on these lines should be made for each job by observation and discussion with experienced and successful workers, and checked with others.

It is well to remember that a successful performance in a job does not necessarily mean full personal satisfaction for the worker; if the job demands a good deal less from a worker than he is capable of doing, a good man may easily become very dissatisfied and eventually unsuitable.

2. *Assessment of the man in relation to the job.* The job specification largely determines what tests are to be applied and what questions can usefully be asked at the interview. Generally information is required about a trainee under the following headings: Physical Capacity, Intelligence, Aptitudes, Attainments, Personality, including temperament and character.

The selection of men by means of properly devised tests or a battery of tests, instead of by blind chance or wasteful trial and error methods, has had excellent results in the Services and in industry whenever they have been properly used. Rarely have men so selected been discharged or transferred for unsuitability. For example in some works misfits have been reduced from 20 per cent. to 5 per cent. by using scientifically planned selection methods. Engineering firms are able to measure confidently a youth's technical suitability for a specialised branch of engineering after one hour's testing. An assessment of his capabilities by haphazard methods would be possible only after several months' work in the shops, probably accompanied by a good deal of strained personal relations or resentment.

The selection of apprentices for more responsible duties in special departments should be based upon a well-tryed system of reporting and grading that operates throughout training or apprenticeship, and should include all relevant information recorded after regular tests, personal observation and occasional interviews. This grading and selection can be carried out with confidence provided such systematic progress records are kept.

So much for the general principles. Now to return to Progress Reporting and Selection of Trainees by the Training Supervisor. Each trainee should have a dossier containing such papers as (1) his application form, *vide* p. 15, Chapter I. (2) A job analysis to serve as a guide. (3) Results of initial tests of all kinds, psychological tests, and tests carried out under training. (4) Periodical progress reports. (5) Results of interviews.

Due credit should be given to apprentices for the actual work done in class as distinct from tests, e.g. notebooks of practical work. Drawings and calculations should be inspected and marked regularly and the marks taken into account for the final assessment.

(1), (2), and (3) have been dealt with, and progress reporting in regard to learning and skills is largely a matter of recording results of tests and noting a man's grade, but reporting on a trainee's personality, temperament and character is vitally important, and should be done as objectively as possible.

In recording the results of tests of knowledge and skills we have seen that it is generally more satisfactory to place men in their order of merit than to attempt to give a marking by an absolute standard. In dealing with qualities of character and personality this principle is again applicable. Assessment of a person's qualities can best be done by considering how each deviates from the average trainee, or what the supervisor from his wide experience has in mind as the average trainee on that particular course.

An instructor's judgment is bound to be coloured by personal likes and dislikes, but this can be overcome to a large extent by considering each quality separately with conscious effort and detached deliberation, in much the same way as a wine-taster considers wine for body, dryness, bouquet, colour, each quite separately at first, before giving a final opinion.

A simple and effective way of reporting on a trainee is to list those qualities that are found by a job analysis to be relevant and important to his work, then allot marks on a five-point scale. This can be done in several ways, depending on what symbols are used to fix the average, and the deviations from it.

The five gradings are: + 2 Outstanding (in the quality)
 + 1 Above average
 0 Average
 - 1 Below average
 - 2 Seriously below average

The symbols A, B, C, D, E, can equally well be used, or the numbers 5, 4, 3, 2, 1, so long as C, and 3 are taken as the average and are not used to indicate a derogatory marking.

An example is given below showing some personal qualities that might be reported on. Each training officer should draw up his own special report form to suit the specific purpose of the training.

<i>Attribute</i>	<i>Marking</i>	<i>Remarks</i>
Technical proficiency		
Adaptability		
Loyalty		
Zeal and Energy		
Ability to stand physical strain.		
Cheerfulness		
Reliability		
Punctuality		
Manner towards others or conduct in the works		
Tact		
Ability to co-operate with others.		

INTERVIEWING

A valuable part of the training course should be a periodic interview with the training supervisor, or education officer.

An interview should be well conducted and impressive, particularly if it is used to help decide which men are to be selected for more responsible posts.

The general pattern for an interview might be as follows:

The interviewer should study all the available reports and papers connected with the person to be interviewed.

Trainees should not be kept waiting as this (apart from being discourteous) makes for nervousness.

Put the man at his ease right from the start by means of a brief friendly conversation; this establishes contact.

Time must be found for proper interviewing. An appearance of haste or irritation at having to spend the time will defeat the purpose of the interview. Fifteen to twenty minutes is an average time. Encourage him to talk. Give him an opportunity to tell you about his personal worries if he has any. These often have a direct bearing on any failure at work.

In routine interviews by the training supervisor it is sound to tell the candidate how he is getting on, early in the interview, as that is the question uppermost in his mind. Tell him also precisely what he must do to improve.

Give him some final and definite advice. It is useless to say to a man: 'You will make the grade if you put your back into it a bit more, or pull up your socks'; it is better to tell him that he should qualify if he spends three or four hours extra per week on his mathematics and pays more attention to his practical note-book.

Discuss his future plans, and leisure activities. Talk frankly about personality weaknesses that can be remedied.

Interview in a quiet relaxed atmosphere. If necessary, stagger the times so there is no queue outside the room.

The interview should end with some words of encouragement, no matter how unpromising the man may be. This ensures that he will give his optimum response to the advice given during the interview. Individual praise or blame makes a deep impression on a trainee especially when given at an impressive unhurried friendly interview, in an informal atmosphere. Here is an example:

Student: John Smith.

PREPARATION.	Study original application form with all his particulars. Job analysis. Test results. Practical work, note-books, progress reports. (Make necessary notes.)
CONTACT.	Rock-climbing and youth hostel interests. Recent performance in firm's dramatic club.
HOW HE STANDS.	Should get a pass, and might get a credit if he can put in more time on Machine Drawing.
HOW HE CAN IMPROVE.	Although good with hands and on practical work, should make a bigger effort over the Theory of Machines. (Show test results to bear this out.) A little more tact needed especially with some of the older men.
PERSONAL AFFAIRS.	Mother's illness. (This explains the low marking for punctuality.) Opportunity to talk. Ambitious for the future.
FINAL ENCOURAGEMENT.	You should make a good foreman in a few years. Keep up your week-end hiking as much as home duties allow.

CHAPTER VII

Learning Curves and other Experimental Results

The principles of good training are based on the accumulated experience of successful teachers and on results that have been obtained from properly conducted experiments on classes or individuals. Some people have a prejudice against anything which seems to be theoretical and will be heard to remark: 'It is all right in theory but how does it work out in practice.' Theory and practice should not be regarded as being by their nature in conflict. Sound theory must be looked upon as that which will explain, guide, and promote sound practice. If theory does seem to conflict with practice, then one or the other, or both, must be modified.

A knowledge of some of the experimentally established facts behind instruction will often suggest to the inexperienced instructor short cuts to greater proficiency.

LEARNING CURVES

One useful investigation is to find out how a class assimilates a subject as the course progresses. There are many ways of investigating this, but the best way of recording the results is to plot a learning curve. The amount of assimilation, or the degree of proficiency in a skill, is plotted vertically, and the passage of time, or the number of lessons, or the number of practices as the case may be, horizontally.

If a man can learn, say, six verses of poetry, or six pages of an engineering manual, in one day, it does not follow that in

fifty days he will be able to learn three hundred verses or pages of the manual. Learning and time are not related by a simple proportion.

A typical learning curve is of the form shown in Fig. 15.

Plateaus.

A steep rise in the curve means that the learning is rapid and when it flattens out the learning is slow. A flattening of the curve is called a plateau and in many subjects

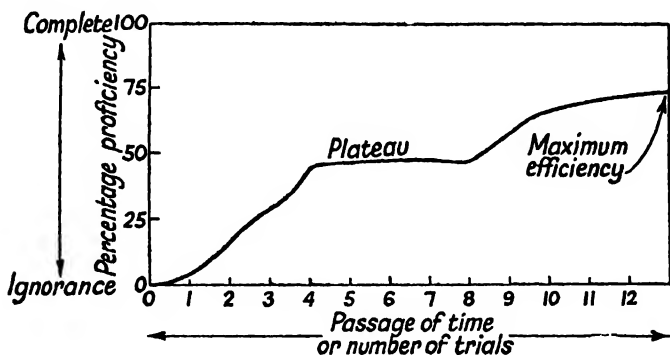


FIG. 15. A TYPICAL LEARNING CURVE.

there are several plateaus. When the curve flattens out finally and does not show any further upward trends, then maximum proficiency has been reached by the learner.

Plateaus may arise from several causes, among them being bad instruction, poor motivation, insufficient theory, insufficient practice, ill health, or even personal resentment against the instructor. Plateaus, however, can appear under normal circumstances or quite inevitably when the causes listed are absent. A plateau may mean that the learner has taken in sufficient for his mental assimilation (or muscular co-ordination in the case of skill), and a period of time is necessary for further progress.

Plateaus mean that the student, whether we approve or not, is taking 'time off' to digest what he has taken in. They are a graphic warning against cramming. Cramming may succeed in giving a little slope to a plateau, but a longer plateau will probably set in later, with an even greater retarding effect on real progress.

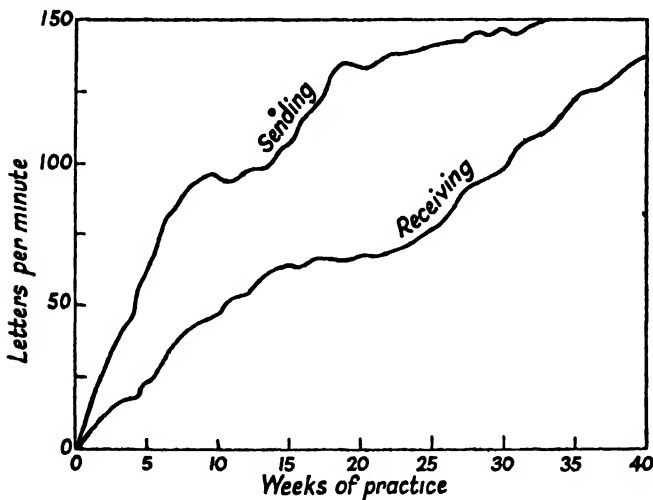


FIG 16 ACQUISITION OF A TECHNIQUE.

Learning curves for receiving and sending telegraphic code for a single man during forty weeks of practice.

An example of a single individual learning how to send and receive a telegraphic code is shown in Fig. 16. The graph shows that the man's rapid learning rate in sending suddenly dropped about the tenth week. The receiving graph shows a block in the learning processes from about the fifteenth week lasting to about the twenty-second week. The wise instructor regards such periods of no progress as something to be normally encountered even under good training conditions, and he should explain to a class or a trainee in a

state of stagnation what is happening and that a further burst of learning can be expected after a pause for assimilation and consolidation.

The Difficulty of the Subject. It is generally found that men learn a hard subject slowly at first, but that progress becomes more rapid as they get a grasp of the essentials. In learning

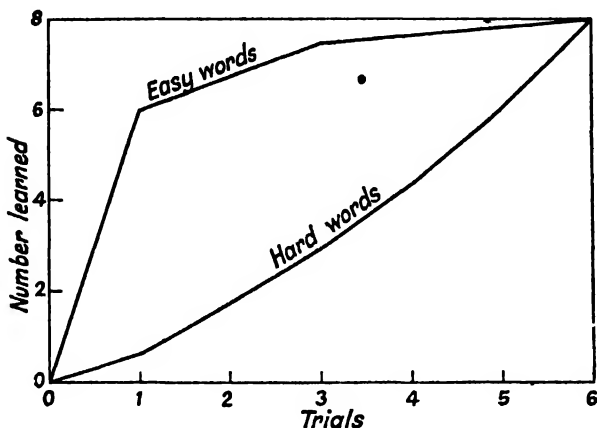


FIG. 17. MEMORISATION.

Learning curves for lists of eight hard and eight easy words. Average records of five men who learnt these lists perfectly in six trials.

an easy subject, progress is at first rapid, and then the rate of learning slows down as maximum proficiency is reached. The graph of Fig. 17 will illustrate this point.

It shows learning curves for lists of eight hard and eight easy words, based on the average records of five men who learnt these lists perfectly in six trials.

This result can be applied in various ways to improve instruction. Easy skills such as filing can be taught with rapid progress at first, but perfection is achieved only after laborious practice. A difficult subject, say armature winding,

needs much harder work on the part of the instructor at first, but if the background skills are there, first-class work should come comparatively rapidly after the initial grasp of the work.

The instructor should explain to the class when approaching a difficult subject that progress may at first be slow, and that an apparently easy piece of work has a period of drudg-

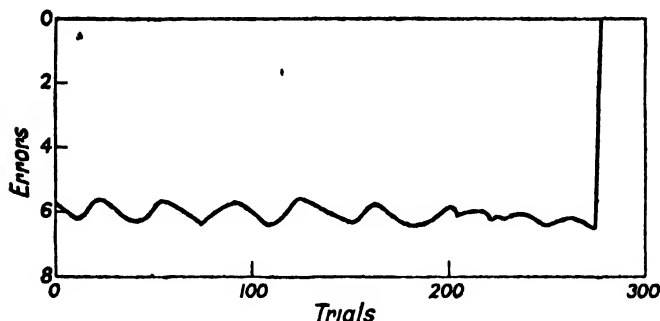


FIG. 18 INSIGHT.

Learning curve of an ape who, to get food, had to choose the left-hand box from a row of boxes which varied from three boxes to five.

ery to be gone through before real efficiency can be reached. These advance warnings may save the class or individuals from a feeling of disappointment over their rates of progress.

Insight. In Chapter V (insight) we saw that students of a difficult subject frequently make an advance by means of a flash of insight, which can be encouraged by the instructor in several ways. The Zoo provides an example of insight in a very rudimentary form. Fig. 18 shows the learning curve for an ape who, to get food, had to choose the left-hand box from a row of boxes which varied from three to five in number. It took the ape over 290 meal-times haphazardly rummaging through the boxes before he suddenly got the

idea of going straight to the left-hand box and from then on he never made another mistake.

There does not seem to have been any logical working out on the part of the animal, but it is more likely that the idea suddenly dawned on him.

The instructor should vary his approach to a difficult point, and should not show alarm or annoyance if the particular explanation which seems easy to him does not produce immediate enlightenment in all members of his class.

A great many technical subjects have points which are difficult to understand and much time can be saved if the instructor, after some experience, decides upon an effective method of teaching them.

When to Test. The learning curve will sometimes indicate the best stage for a test or examination; consider Fig. 19.

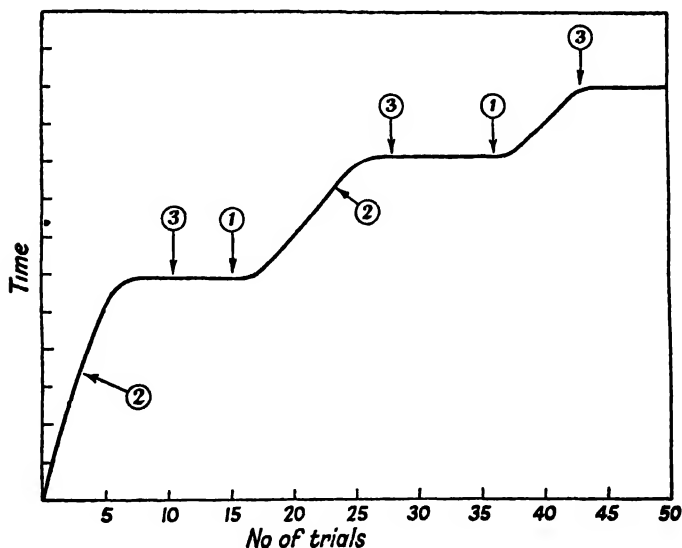


FIG. 19.

Position (1) is not a good time for a test because this point is at the end of a plateau and the class morale may be low as the students may have a feeling that they are making no progress and the subject is either difficult or boring. Position (2) is not recommended because here the learning is very rapid and by postponing the test a short time it would be

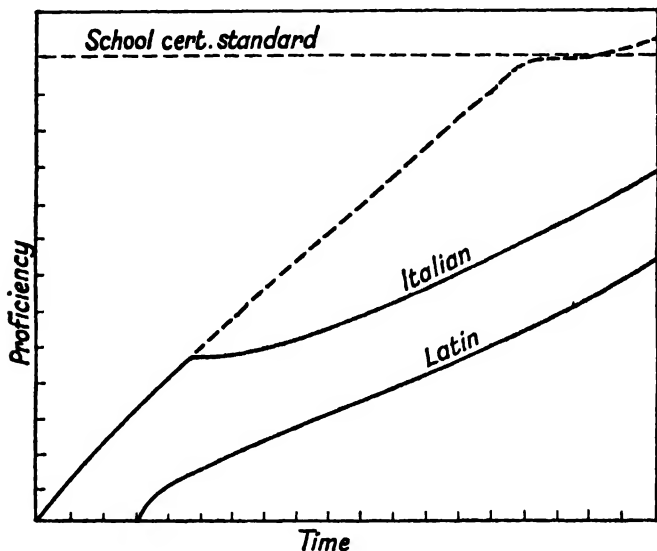


FIG. 20.

possible to test much more. The best place is at (3) where a period of consolidation is about to set in.

Learning two or more Subjects together. In nearly all courses students have to learn more than one subject. It is important to realise that two subjects can help each other, or can interfere with each other and cause confusion in the mind of the learner. This confusion brings about inhibition. As an example a boy starting to learn Latin and Italian together

may very easily become muddled in his vocabulary and grammar so that the two subjects inhibit good learning (see Fig. 20). On the other hand English literature and English history could be taught so that they tend to reinforce each other. The boy might find English history rather dull and difficult to remember, and similarly English literature by

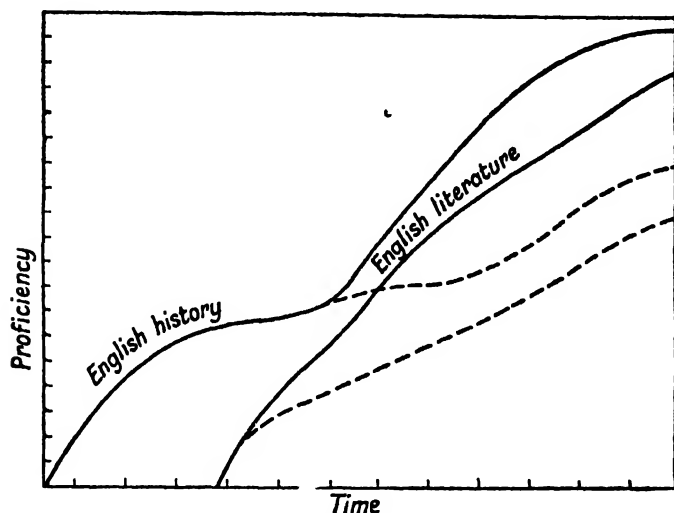


FIG. 21.

itself might seem uninteresting, but if taught side by side with references each to the other, the two subjects could be developed to build up a greater interest than can be found in either of them singly. This is shown in Fig. 21.

Applied mathematics and physics are subjects which, properly taught, can reinforce each other considerably. Fig. 20 and Fig. 21 will illustrate these points. No set rule can be given for subjects that will inhibit or reinforce, but in general two or more similar subjects taught in the same course may cause inhibition whereas learning two or more

aspects of the same general subject will produce a reinforcement. For example A.C. and D.C. machines taught in alternate lessons would almost certainly produce inhibition, but vector algebra and alternating currents could be studied side by side with advantage.

SATURATION

A final hindrance to learning, that can be demonstrated by experiment, is that of saturation. This is simply an overloading of the student with a mass of information on the same subject particularly if the facts given have no logical connection. It is no use presenting facts in a piece of instruction unless they are either useful in developing the subject or likely to be memorised. In that humorous history-book, *1066 And All That*, only one date was acknowledged to be memorable and there is a certain amount of wisdom in this austerity over factual knowledge.

Saturation can be demonstrated as follows: Allow a class to listen to a factual talk on the wireless for half an hour and three days later ask the class to write down all they can remember of the talk. A week or so later repeat the experiment with a comparable ten-minute talk on a similar subject and it will be found that slightly more of the ten-minute talk can be remembered than the half-an-hour talk. Saturation sets in when the learning is fast and continuous, and saturation point is reached sooner when material to be learnt consists of a series of similar facts. A fuller appreciation of this would improve many pieces of instruction, in fact disregard of the saturation point is perhaps the most common fault of all instruction.

To show the serious effect of saturation, the following is an experiment (taken from the Army book *Good Instruction*) using a film heavily loaded with facts.

Two groups of men of the same average intelligence and age took part in this test. A thirty-minute film was selected

which had as its aim to teach the organisation and duties of a certain type of work. The facts taught were of the sort that could easily be confused, for example the detailed organisation of similar departments.

1. Group A were shown the film right through. The film was then discussed for thirty minutes and summarised by the instructor. Next came a second showing with the instructor's final summary.
2. The same instructor showed the film to group B in three ten-minute sequences. After each sequence there was a discussion followed by a second showing of the same sequence followed in turn by a summary.
3. The same total time was thus expended on each method of presenting the film. Three days later a test on the subject-matter of the film was set for each class. The result was:

Group A: 28.8 per cent.

Group B: 78.3 per cent.

Investigations of the state of learning after each showing gave the following results: After the first showing a very large portion of the film appeared to make no impression on account of saturation. The beginning of the film was remembered apparently because the mind was fresh. The end of the film was remembered probably because the final impressions were reinforced by the relief afforded by the ending of the film. Even after a second showing of the film to group A the same saturation effect, for a large part of the middle of the film, was in evidence. This is made clear in Fig. 22 where the shadowed portion corresponds to a mental black-out caused by saturation.

In the case of class B where the film was shown in ten-minute sequences, each sequence achieved approximately the same amount of useful learning as the first and last block of five minutes in the method used for class A. A

repetition of this method of showing practically eliminated the effect of saturation. Fig 23 illustrates this.

This experimental result has a very wide application and, although it is unwise to generalise on this subject, it is useful for the instructor to appreciate that most classes will

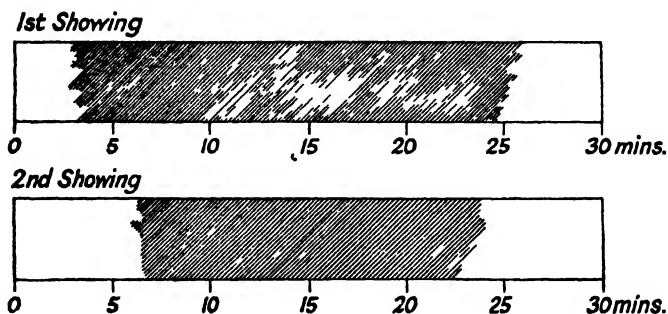


FIG. 22. CLASS A.

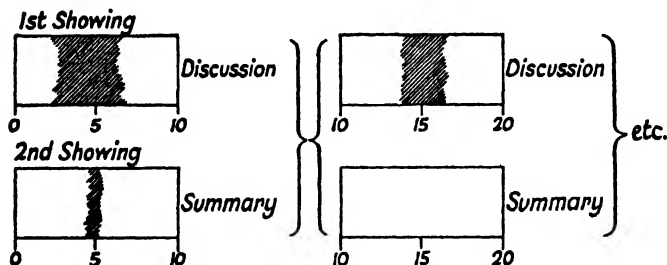


FIG. 23. CLASS B.

reach a saturation point after about ten minutes of intensive passive instruction whether it be talking, demonstration or film-showing. After that period the learning must be confirmed either by means of a summary, by actual practice, by means of questioning or tests, or by 'giving back'.

A training officer who wishes to study in detail how learning is proceeding for a certain piece of instruction would be

helped by plotting a suitable learning curve but to do this it is necessary to have a great many opportunities for collecting results, as conclusions drawn from a few samples will not be reliable. The test must be carried out with care and conditions must be unchanged for a series of tests. Full consideration must be given to any factor which might invalidate the results.

FATIGUE AND EFFICIENCY

Fatigue can be physical, mental, or a mixture of both. Prolonged mental exertion produces mental fatigue in a trainee; his eyes and face-muscles feel tired; he will become irritable; and he will avoid brainwork and find it difficult to make decisions or to concentrate.

Mental fatigue can be overcome by sleep or recreation, including any activity which will hold his interest without making demands on his mental powers. Physical fatigue can be overcome by complete relaxation and sleep aided by suitable food and drink. The two performance graphs (Figs. 24 and 25) are given as examples to illustrate how physical and mental fatigue affect a man's efficiency in performing mental tasks.

In Fig. 24 a man was given a number of arithmetical problems consisting of the mental multiplication of two sets of four-figure numbers. Starting at eleven o'clock in the morning he continued without a break until eleven o'clock in the evening, completing sixty-seven problems. The time taken for each problem increased from five minutes for the first to about ten minutes for the last. This shows the steady effect of fatigue.

A different man was given the same test starting at 11 p.m. after a full day's work. For the first twenty problems his performance was much the same as the first man, as he took about one and a half hours. At this point his capacity for sustaining mental effort broke down completely as the next

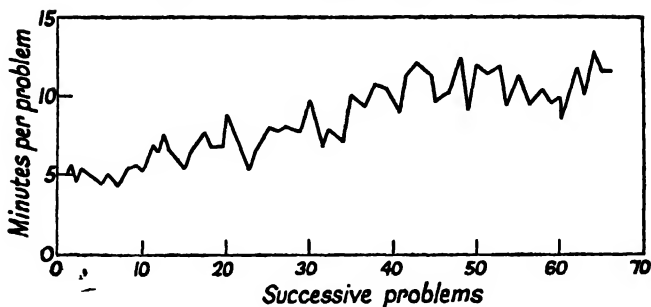


FIG. 24. MENTAL FATIGUE DURING THE DAY.

Decrease in mental efficiency as a result of mental multiplication over twelve hours during the day.

problem took up to twenty-five minutes and he was unable to continue (Fig. 25). Even making allowances for the different conditions and temperaments, these instances support the

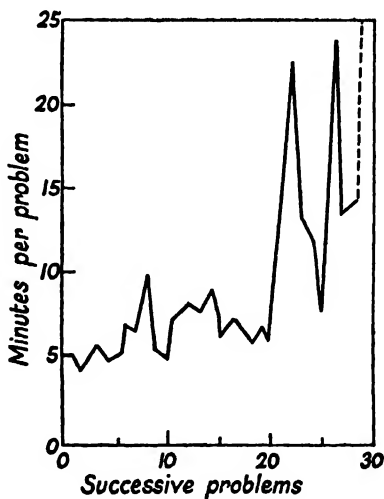


FIG. 25.

generally recognised fact that a man's vitality is at its highest during the middle of the day but is lowest at night. There is a natural rhythm in man's activity which it is hard to change.

Fig. 26 illustrates how proneness to fatigue varies at different times of the day and night. Even when a man has been awake all night he will experience a renewal of energy round about dawn. The precise pattern of this rhythm varies with individual temperaments, with climatic con-

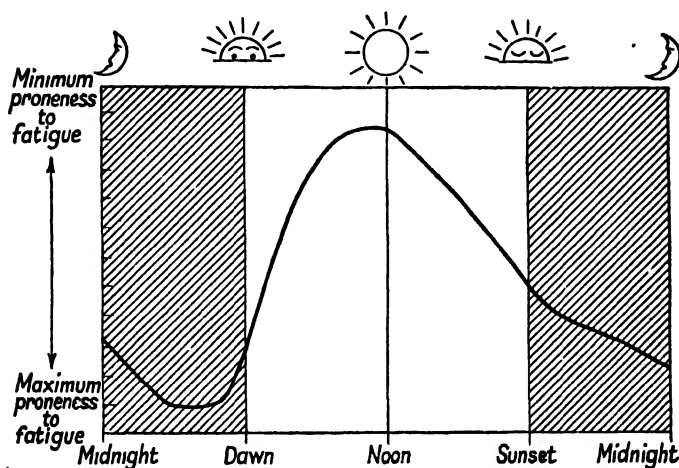


FIG. 26.

ditions and with habits of life, but it nevertheless affects all men so that from the instructor's point of view, consideration should be given to this factor in setting men tasks.

The most exacting work of the day is best planned between breakfast and the midday meal. The more interesting work should come later in the day. Arduous mental work late at night is not as profitable for the learner as an equivalent time in the middle of the day. This rhythm in industry shows itself in the following typical work curve of a manual

labourer where fatigue can be regarded as steadily cumulative (Fig. 27).

Breaks offset the effects of fatigue. The efficiency lost by fatigue can, to a large extent, be counteracted by a wise use of breaks in the work. The initial rise in the graph shows that it takes a man some time to get settled in his work. It would be clear that too many breaks will produce a loss of time that will counteract the gain from offsetting fatigue. It is more efficient to remedy fatigue before it becomes too acute; a

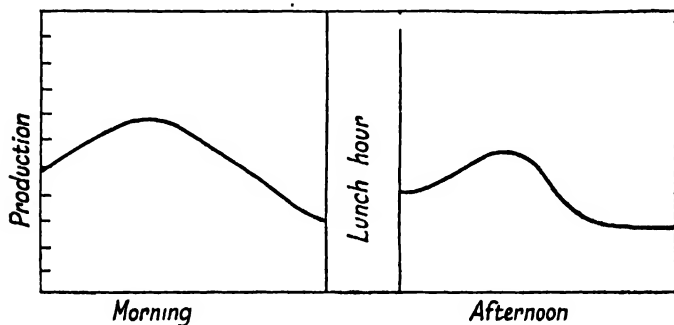


FIG. 27

short rest can restore full efficiency if the fatigue is not great.

In Fig. 27 the best position for a work-break would be just after the peak of morning and afternoon production. The results of introducing this work-break at these times are not quite what would be expected, as psychological factors play a part. For instance the anticipation of a work-break will cause a slow start but produces an increased output before the break arrives, as shown by the dotted line in Fig. 28. This tendency is again apparent in the second part of the morning, but the man on the whole worked more efficiently. In the afternoon the break seemed more distant and he worked well, falling off just before a break was due,

possibly because he expected it sooner. On the whole he finished off the day's work more efficiently than at any other time. Studies such as these show the value of well-planned work-breaks.

For a class under intensive instruction there is no simple method of estimating the degree of fatigue of the class, but it is generally true that a period of forty-five minutes' instruction is the maximum that can be reasonably endured without a break or without serious loss of efficiency. Further, the

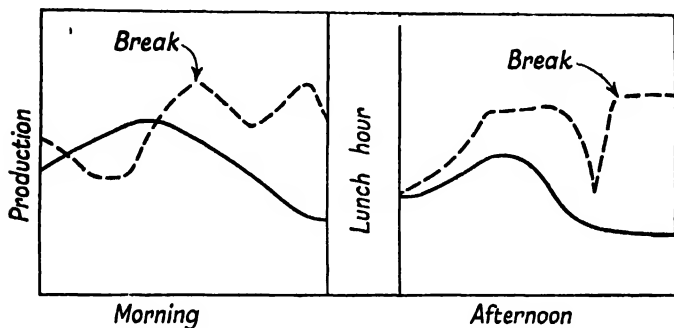


FIG 28.

value of the break depends both on its length and in the way in which it is spent.

A production plant in the United States of America introduced a fifteen-minute work-break in the middle of a two-hour period of work. When the break was spent in complete relaxation, comfortable chairs being provided, production went up 9·3 per cent. When it was spent in walking about the increase observed was only 1·5 per cent.

When the work is really strenuous, a break should be spent in proper relaxation, sitting down, and should not be too long or muscles will become stiff; and it should not be too short or the rhythm of the work will be interrupted—with only a small check in the onset of fatigue.

Having seen the importance of work-breaks, it is essential in any training time-table for instructors or technical teachers to observe strictly the time-table and not encroach on these breaks as this is unfair for the next instructor or for the next part of the programme. In some programmes it is advisable to have short breaks every forty-five minutes with a half-hour break in the middle, but under such circumstances the half-hour break should not come in the middle of a piece of practical work, otherwise the trainees will find it difficult to start again at the point where they left off. This applies particularly to practice in skills and techniques.

Learning must be assimilated to a certain standard before it is safe to break off; then the break should be long enough to overcome the onset of fatigue, but not long enough to allow learning to be lost. Fig. 29 shows an example taken from a test on ten men learning a skill for the first time (the test was changing a part on an intricate piece of mechanism). During the first four trials learning progressed rapidly. After a break of five minutes no accuracy was lost and only a little speed was sacrificed. At the sixth trial maximum accuracy was reached, but then fatigue, and possibly boredom, set in. After the tenth trial a half-hour break was given. On recommencing the trials accuracy was found to have badly deteriorated; it took seven more trials before the old maximum was reached and another two trials before there was any improvement.

In Chapter V we have seen the importance of variety in maintaining interest. Variety in occupation and in the training programme serves much the same purpose as rest; in fact, 'a change is as good as a rest'. This is generally taken into account as a matter of common sense in drawing up a training time-table. For instance, use might be made of a film, or by using discussions in place of lectures, visits outside the class-room, practical activity interspersed with theoretical work. A final warning: no matter how well the time-table

is arranged, no amount of artistry in arranging breaks and variety in programme can offset the results of accumulative fatigue if the hours of work are too long, and the intensity or tempo of the work is too high.

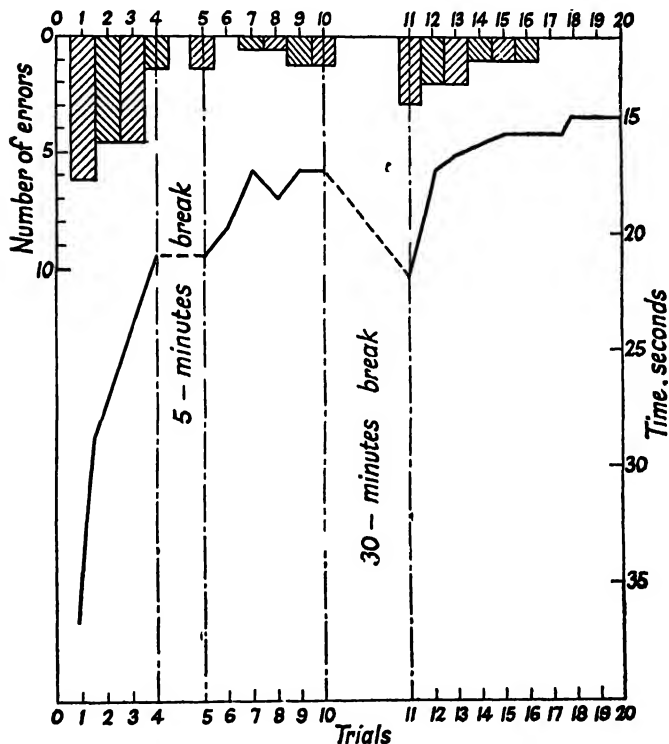
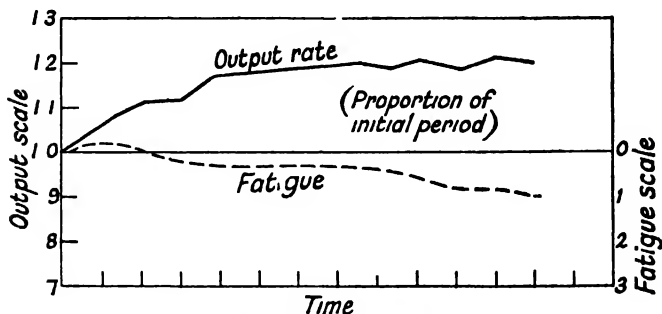


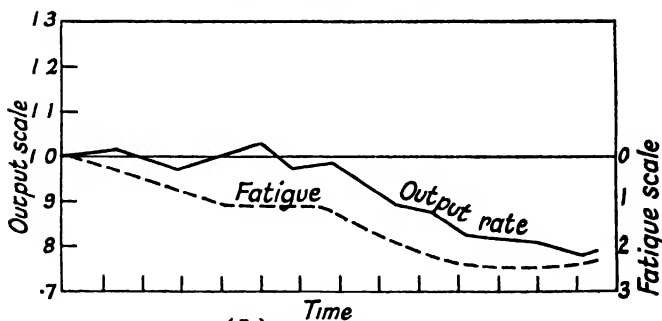
FIG. 29. BREAKS IN CONTINUITY OF LEARNING.

In a factory it was found that by reducing the working week from fifty-eight to fifty hours, the weekly output was actually increased by about 20 per cent. In a long course of training this principle, together with that of saturation,

should warn the training supervisor to guard against fatigue and staleness, and to take measures to arrest it at an early stage. It is important to remember that fatigue can be overcome by an effort of will. Fatigue is not like a drug which



(a) Intelligence test



(b) Addition

FIG 30 EFFECT OF FATIGUE

cannot be struggled against, but is intimately associated with will-power

An explorer on the point of making an important discovery or a scientist about to unravel a new mystery may be motivated to work harder and faster in spite of considerable fatigue. In brief, motivation offsets fatigue. Fig. 30 shows

an attempt at measuring the effect of fatigue on men when motivated and when bored.

A class was set a series of intelligence tests and a series of addition sums; as the work progressed their output was recorded, and they marked down the fatigue they felt on a ten-point scale from 1—'no fatigue at all' to 10—'too tired to work'.

The class found the intelligence tests interesting and their output consequently increased, in spite of a steadily increasing fatigue. The task of addition proved to be dull and this meant poor motivation and a steadily decreasing output as fatigue increased.

In arranging a programme, it is often preferable to ensure that men are well motivated rather than to ensure they are not fatigued. Motivation can offset fatigue and it is more profitable to instruct a man when he is tired and interested than when he is fresh and bored. Men should be trained to withstand normal fatigue, as a man who gives up at the onset of a feeling of fatigue is useless in any worthwhile job. Opportunities for strenuous work under difficulties which produce fatigue can be provided as a part of training, but it is a piece of character training as distinct from technical teaching and calls for special qualities of tact and leadership on the part of the instructor.

THE PACE OF INSTRUCTION—TEMPO

An instructor will find that the pace and interest of his programme will vary from hour to hour, from day to day, from week to week. Some parts of the work are full of interest, stir up enthusiasm and require a great output of energy; other parts are dull and seem to drag. Keenness and enthusiasm will naturally fluctuate because it is impossible for a man to be in a state of intense interest or enthusiasm for a prolonged period. The most enthusiastic musician could

not listen to music demanding a high state of aesthetic interest for hours on end.

The word tempo is applied to the pace or degree of interest and energy demanded for a piece of instruction. It is impossible to make any rules governing the way in which tempo should be increased or decreased during a lesson or a course, but a study of this question has produced a few general principles.

A lesson which requires a short period of great activity should start at full speed and continue at high pressure to a central climax. Some loss of tempo in the second half is inevitable, but the lesson should culminate in a final burst at maximum pressure. This is illustrated in Figs. 31 and 32. The period of instruction was one in which the instructor taught a new skill and revised several old ones. The skills were such that they demanded high activity.

The first lesson (Fig. 31) began with a verbal summary of past skills calling for little activity from the class. Practice by individuals in these old skills increased the tempo a little, but it soon decreased as boredom increased. The explanation, demonstration and practice of the new skill were not of sufficient appeal to rouse the class to real enthusiasm and lively action, so the lesson closed quietly.

The second arrangement (Fig. 32) shows the lesson starting with a practical test of skills already learnt and this start was therefore one of high tempo. After explanation and demonstration the class went on to practise the new skill motivated by the anticipation of a competitive test in a few minutes' time. The tempo was allowed to drop during the revision and practice, but the period finished at full speed with a final set of competitive tests. It is important to note that the tempo of the period depends not only on the planning and arrangement of the lesson, but also on the enthusiasm and manner of the instructor.

With regard to the day's programme we have seen that

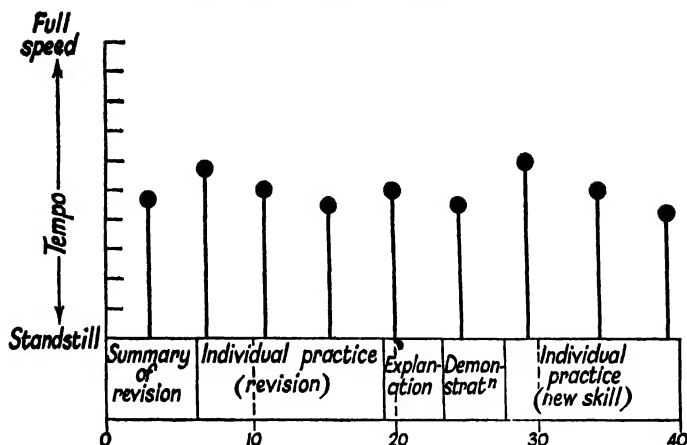


FIG. 31. TEMPO OF SKILL PERIOD—1ST ARRANGEMENT.

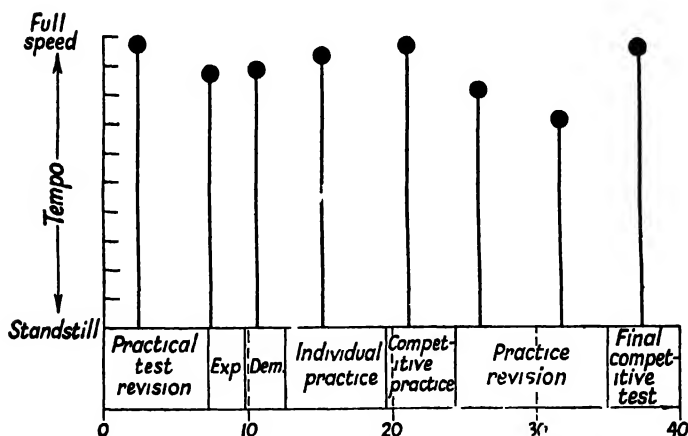


FIG. 32. TEMPO OF SKILL PERIOD—2ND ARRANGEMENT.

work which demands the greatest effort is best fitted in between breakfast and lunch. When students are tired or in an afternoon frame of mind, periods which demand little

physical and mental energy are advisable, but for testing purposes a student should be called upon to produce high activity at any time. The tempo of each day must be given separate consideration, taking into account the subjects being taught and the larger cycle of training. In many cases the tempo of a day's work could be improved, as shown in these examples from army training where the second arrangement is clearly more effective than the first (Figs. 33 and 34).

The instructor should strive to work the class at its maximum tempo for the type of work and time of day. Men on a technical course should be trained to work as quickly as possible and at maximum efficiency, so that the training may make a full contribution to production.

GROUP STRUCTURE

Our social system consists of an intermingling of numerous groups; the family, the club, the office. A man's character is not formed solely from within himself but is determined to some extent by the group of which he is a member; he will tend to identify himself with the ideals and thoughts of the group and he will be influenced by his relations with the other members of it. Personalities within any particular group become mutually adjusted each to the other, and this makes it possible to recognise certain particular characteristics of, for example, the only child, a successful business man, a schoolmaster or a naval officer. This network of personal relationships forms a 'group structure'. A class under training is a small community with its own group structure.

The farmyard gives a simple example of this structure in a very rudimentary form. If a number of hens are put in a run together for a month or two they rapidly become a social group with a simple structure of which a 'pecking order' is one of the characteristics. Hen (1) will peck all other hens but is rarely pecked back. Hen (2) will peck all but hen (1)

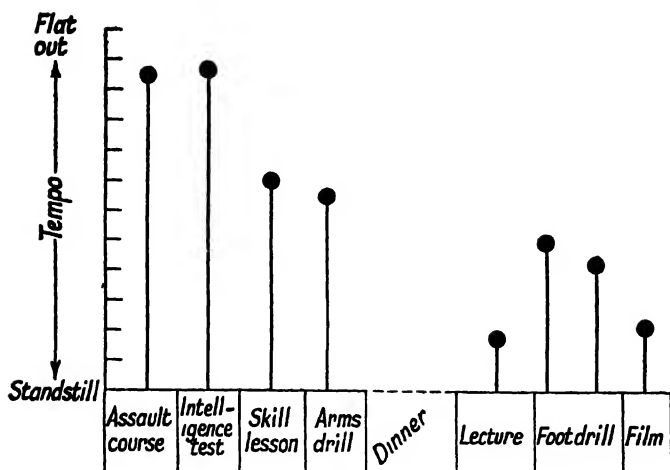


FIG. 33. DAY'S PROGRAMME—1ST ARRANGEMENT.

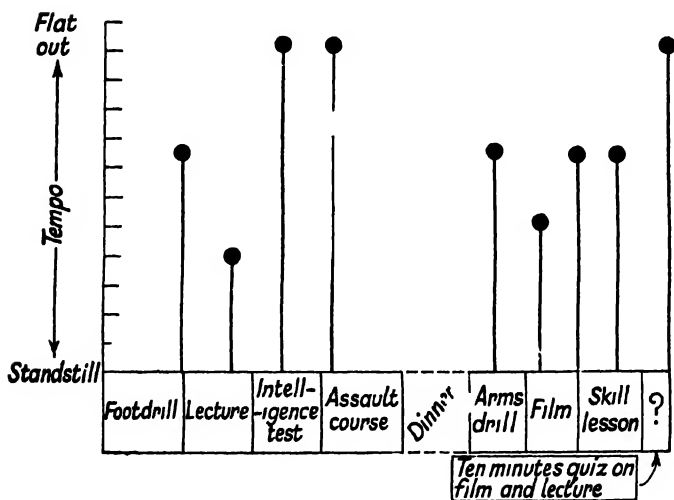


FIG. 34. DAY'S PROGRAMME—2ND ARRANGEMENT.

and will enjoy immunity from all but her, and so on until the last hen is pecked by all without any apparent right to peck back. Individual characteristics become apparent. Hen (1) appears full of confidence and poise. The last hens in the 'pecking order' are maladjusted, vicious and a source of trouble. Keeping the hens in a group, however, is on the whole more satisfactory than keeping them alone. Egg production by the group is greater than that for the same number of hens kept in isolation. Men work much better in groups than as individuals. Although our present civilisation has been achieved by the constant striving of men to get the better of each other by socially accepted methods, yet the real secret of human progress is the fact that man can be unselfish, and work as a member of a team or a community.

One of the characteristics of a flourishing community is that the members are good mixers and a few of them brought together with some common purpose will soon weld themselves into a group with a leader and an organisation. A spirit of work will emerge which will be characteristic of that group. A variety of terms have been applied to this group spirit, such as 'esprit de corps' or group morale. The Boy Scout movement makes excellent use of it in the patrol system which encourages the gang loyalty of boys which is a great aid to character-training. A firm or a large organisation, if the group structure is sound, will be able to recognise the following gradation in the structure.

Me;
Bill, Bert, and me;
Our class, our shop;
Our department;
Our firm;
Our industry.

Groups are generally from three up to about seven men and each group will usually be centred round one or two

dominant personalities. These men largely determine the tone and standard of the group. Under the influence of good dominant personalities the group's performance will be higher than the sum of each individual performance; under bad influence—that is, one which is contrary to the best interests of the firm—the group will be a disruptive element or a subversive clique which can readily give a wrong lead to another large group. It is advisable under these circumstances to break up such a group. A sound group structure can encourage loyalty and good personal relations and should be encouraged to mature. There is a vast difference between an expert team of footballers when first brought together from different parts of the country and the same team after it has played together for a season. The practical point of all this for the instructor is that a group of men should be recognised as a natural unit and that men should not be changed from class to class or group to group haphazardly but only for special reasons. During training and teaching, use small groups of friends as units in competitions as this develops a healthy group structure which ultimately promotes loyalty to the firm. When a number of men are presented for training and have to be divided into two classes there is a temptation to select the two classes alphabetically or by some quite arbitrary method. The most effective way of arranging for the class is to grade the men according to their ability, that is, put the best men in one class, and the rest in the other class. Care should be taken that the classes are called by letters which will not indicate which is the better class, otherwise group morale of the lower class may suffer. By grading classes in this way a more satisfactory group structure is secured and the learning is more efficient. Competition within each class is keener. Good instruction is easier and as the speed of assimilation is more uniform in each class, time is saved. A large gap in ability in performance between the best and the worst men is a serious problem for

the instructor. Experience shows that specially brilliant students tend to depress the worst students and not to inspire them.

There are, however, some disadvantages in dividing a class by ability. The different abilities may call for a modified syllabus and all members of the class will not reach the same standard together, but this disadvantage will be offset by each student being given the best conditions for assimilating fully what is taught.

Factory life in this half of the twentieth century offers some compensation for the drudgery of repetition work; it provides a social environment and a sense of belonging to a team, and a community. The old community life of the village and the parish, with the church at the centre of this life no longer exists in large industrial towns. Workers often live in dreary suburbs and look to the firm for their sport, recreation, club life and fellowship.

Social relations in a large firm are today complex and influential—for good or ill. So that in the words of Sir George Shuster, 'We stand at the beginning of a social revolution.' Training in industry must be sensitive to and responsive to these changes.

PLANNING A SYLLABUS

A syllabus is the scaffolding around which training is built. The first step in planning a syllabus is to define clearly the object of the course. The object of the training may be laid down in a directive from management, or it may be largely dictated by the requirements of a recognised examination.

The senior instructor planning the syllabus must keep this object constantly before him and he should make a detailed study of all the requirements. The same is true when a syllabus needs revision, but here the adequacy or otherwise of the existing syllabus can be assessed by inquiring how

far it has succeeded in achieving its object. This inquiry should be directed both to the departments that receive the men trained and also to the trainees themselves.

Suppose we have trained twelve men for ten weeks to be wiremen, we should like to know what weaknesses the receiving department found in the training. This may entail a systematic inquiry guided by a job analysis. This may reveal for example:

- Principles of testing very weak in all trainees;
- Installing metal conduits good in most;
- Wiring regulations not well grasped.

Then we could ask individually a selection of the men trained, 'You have been on this wiring job now for two months. Did you find the course gave you the right start? How could we make the course more useful?'

A good training department will maintain close contact both with those who decide what the object of the training shall be—what is required—and with the finished product of the training course, i.e. the trained men at work. Without this close contact and co-operation, instruction will be unrealistic and ineffective. Instructors exist to supply the needs of industry, and they must be fully aware of those needs.

Having clarified the object of a course, the main subjects have to be decided, and these have to be broken down into sections. The compilation of a detailed description of the requirements for the job is valuable for the instructor and often revealing to management, as the exact requirements for even a low-graded job may prove to be quite impressive to officials who have not given such matters much thought.

A detailed job analysis for all jobs will help to check any overlapping and will suggest common background subjects in training, e.g. history of the firm and its products. The training supervisor should examine these ingredients of the

syllabus and decide how each part contributes to the main object and how important that contribution is.

In preparing a lesson, it was suggested that material for presentation should be sorted into *must* know, *should* know, and *could* know. The same procedure applies to the planning of a syllabus.

The next step is to consider the time available and the receptive ability of the class, in the light of what must, should, and could be known. The way in which time should be apportioned between theory and practice was dealt with in Chapter II. An understanding of the importance of each subject in the syllabus and the time required to teach it effectively is essential.

There is a tendency to allot time only on the basis of the *importance* of the subject, ignoring the time required to *teach* the subject adequately.

A simple example is given in Fig. 35, where each block represents a subject shown in its relative importance, assessed by its contribution to the object of the course, and therefore a course of say forty hours would be divided up as follows:

A 10 hours,	B 7 hours,	C 6 hours .. must know
D 5 hours,	E 4 hours,	F 3 hours .. should know
G 2 hours,	H 2 hours,	I 1 hour .. could know

This however is not a sound method, because it is clearly better to decide how long is *really required to teach* A, B, C. Suppose the answer is thirty-two hours, then only eight hours are left to teach D. At this point the training supervisor should make the position clear to his seniors to whom he is responsible. He can teach either A, B, C and D in the time allotted, or all subjects to achieve the full objects of the course, if given another twelve hours. Figures and arguments of this sort are cogent only if based on experience.

The first method might produce a smattering of all the subjects with no real proficiency. The second method

ensures that the 'must know' parts are thoroughly mastered as they ought to be.

The two approaches to the problem can be recognised. One asks: 'How long can I give them to learn this subject?' The other: 'How long will it take to learn this subject?' Training men properly and efficiently demands conscientious application of Method Two.

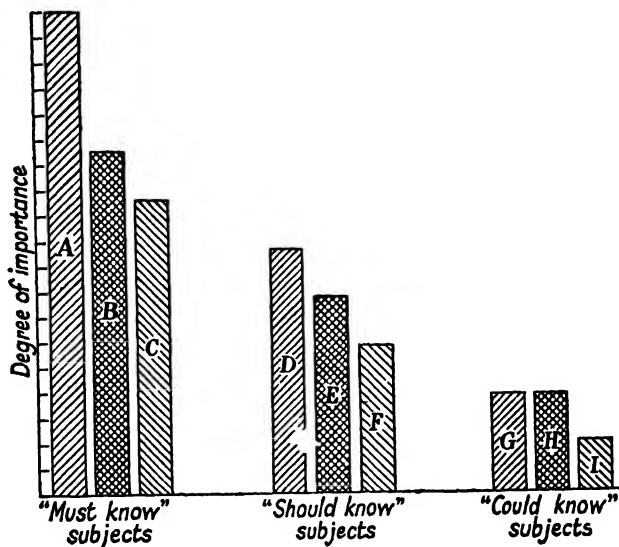


FIG. 35.

Some technical courses which aim at keeping men up to date are more satisfactory if made short and given frequently rather than made longer and given less frequently. This is specially true in subjects such as telecommunications where developments take place rapidly.

An employee taken off a job and deputed for a course is apt to grow anxious if too long away from his normal work.

A training course should not be put on when work is slack as this creates the impression that training schemes are a means of maintaining a labour pool, from which men can be withdrawn as required. Such an impression will undermine confidence in the value of the training given.

It has been emphasised from time to time that the development of essential personal qualities in the trainees is an important part of any technical training programme and this aspect of training should not be lost sight of in planning a syllabus.

Some parts of the syllabus, such as general lectures, have very little character-training value, other parts, e.g. competitive practical tests in teams under elected leaders, have a high value. Parts of the syllabus involving team-work or perseverance bring out personal qualities without which the whole training programme can be a waste of time.

The planning of training courses is often made easier if a master syllabus be used as a guide. An example of a master syllabus for a Record Clerk is given as an example.

Refresher courses are important, for although they devote a good deal of time to background subjects, they have as their object the maintenance of the employee's interest and loyalty, by keeping him up to date on the firm's aims and policy—especially on problems affecting management and employees.

Training as a Whole. Technical training must be continuous and progressive, and should grow into a unified and coherent whole. This means that the subjects and subdivisions of each subject (which for convenience are often taught in isolation) should eventually be brought together in a well-devised exercise, or a comprehensive practical test job, to unify them.

For example, when training a lorry-driver who will have

[continued on page 152]

COMPILATION OF MASTER TRAINING SYLLABUS FOR ANY GRADE OF EMPLOYEE

Explanatory Note: The grade of RECORD CLERK has been used in the master syllabus on the next four pages, which is intended to be nothing more than an illustration of the *method* of compilation. The detailed content, and the number and duration of the courses required by record clerks in any particular firm, will depend on the type and complexity of the records kept—this illustration should not be regarded as a guide to these matters. In any firm, an induction course, followed by one or more job training courses, will be required by all new employees; but the need for promotion courses for a particular grade will depend upon whether the grade covers complex or responsible work. If it covers only simple routine work, employees suitable for promotion will not remain in that grade. Whether the work of the grade is simple or complex it is desirable to hold 'refresher' courses from time to time; the intervals between such courses can vary, and will depend upon the circumstances of the firm.

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SUBJECTS	Course 1 <i>Induction and Preliminary Training</i>
1. Welcome by Company Official	½ hour
2. Industrial Background (a) History of the industry (b) Present position—products and markets, types of firm and their organisation (c) Current and future developments and problems	(a) ½ hour (b) 1 hour
3. The Company (a) History products and their uses, aims and policy of the firm (b) Management—organisation of the firm, senior officials and their functions, work of main departments, tour of all departments (c) New policies, new production programmes, new products, changes in organisation	(a) ½ hour (b) 3 hours
4. Legislation (a) National insurance, income tax, workmen's compensation (b) Changes in relevant legislation	(a) ½ hour
5. Health and Safety (a) Firm's health services, accident prevention, fire precautions, procedure in case of illness or accident at work (b) Changes and developments as under (a)	(a) 1 hour
6. Company Personnel Policy and Procedures (a) Conditions of employment and staff rules—hours of work, salaries, and method of payment, holidays and sickness absence, time-keeping and time recording, attendance and leave of absence, the staff code (b) Training and education schemes, promotion policy and opportunities (c) Co-operation, staff council and committees, staff representation, function of the personnel department (d) New policies and practices as under (a), (b), (c) and (d)	(a) 2 hours (b) 1 hour (c) 1 hour

Course 2 <i>Job Training: Simple Records</i>	Course 3 <i>Job Training: Fairly Complex Records</i>	Course 4 <i>Complex Records (promoted staff)</i>	Total Time Required for Basic Training	'Refresher' Courses <i>(1 week, afternoons only)</i>
			$\frac{1}{2}$ hour	
			$1\frac{1}{2}$ hours	(b) 1 hour (c) 1 hour
			$3\frac{1}{2}$ hours	(c) $2\frac{1}{2}$ hours
			$\frac{1}{2}$ hour	(b) $\frac{1}{2}$ hour
			1 hour	(b) 1 hour
(a) 1 hour	(a) 1 hour	(a) 1 hour	10 hours	(d) 3 hours
(b) $\frac{1}{2}$ hour	(b) $\frac{1}{2}$ hour	(b) $\frac{1}{2}$ hour		
(c) $\frac{1}{2}$ hour	(c) $\frac{1}{2}$ hour	(c) $\frac{1}{2}$ hour		

150. TECHNIQUES OF TECHNICAL TRAINING

SUBJECTS	Course 1 <i>Induction and Preliminary Training</i>
7. Staff Amenities and Services (a) Cloakrooms and toilets; canteen facilities; rest and recreation rooms (b) Pensions scheme; sick benefit club; benevolent fund; savings; sports and social club (c) New developments as under (a) and (b)	(a) $\frac{1}{2}$ hour (b) 1 hour
8. Sources of Information (a) Methods of informing staff of new policies, rules and procedures (b) Departments and officials dealing with queries; policy and procedure covering complaints and grievances	(a) $\frac{1}{2}$ hour (b) $\frac{1}{2}$ hour
9. Background of the Job (a) Introduction to head of new department and supervisor; work of department and relationship to other departments; departmental layout and sequence of operations (b) Departmental routines (c) Changes and developments in work of department; new departmental routines	(a) 1 hour (b) $\frac{1}{2}$ hour
10. Specific Job Knowledge and Skill A. Purpose and functions of records; types of records; firm's record systems B. Purpose of employee's specific job; duties and responsibilities; work methods and procedures; forms and symbols used (theory) C. Job demonstration and practice under supervision D. Standards of work—accuracy, speed, neatness, economy; standards required and reasons for them; queries and errors E. New types of work; changes and developments under A, B and D (theory and practice)	A. 3 hours B. $7\frac{1}{2}$ hours C. 15 hours D. 1 hour
Total Time Required for Training	41$\frac{1}{2}$ hours (1 week)

Course 2 <i>Job Training: Simple Records</i>	Course 3 <i>Job Training: Fairly Complex Records</i>	Course 4 <i>Complex Records (promoted staff)</i>	Total Time Required for Basic Training	'Refresher' Courses <i>(1 week, afternoons only)</i>
			1½ hours	(c) 1 hour
			1 hour	(a) ½ hour (b) 1 hour
(a) 1 hour (b) ½ hour	(a) 3 hours (b) 1 hour	(a) 5 hours (b) 5 hours	17 hours	(c) 2½ hours
B. 15 hours C. 22 hours D. 1 hour	A. 2 hours B 29 hours C. 44 hours D. 2 hours	A 10 hours B. 60 hours C 82 hours D. 2 hours	295½ hours	D. 1 hour E. 2½ hours
41½ hours (1 week)	83 hours (2 weeks)	166 hours (4 weeks)	332 hours (8 weeks)	

to be responsible for some care and maintenance of his lorry, there are many aspects of the job to be taught. These should not be taught in complete isolation, but the inter-connections should be pointed out. To prepare the way to a unification of the subject-matter, the instructor should begin by taking the trainee out in a lorry to give him an insight into the job, and an understanding of what is required for skilled and intelligent driving. In this way there is formed early in training a conception of the whole body of knowledge and skills to be learnt. Sections such as the gears and clutch operation, the braking system, the electrical system, fault-finding, steering mechanism, and the Highway Code, even though necessarily taught in isolation will not then appear to be so isolated.

A liberal amount of time should be devoted to trials which call for a full understanding of the whole job of driving and maintaining a vehicle.

This principle was advocated in Chapter II when considering what sequence a lesson on a piece of mechanism should follow, and can be summarised as:

- (1) General function and purpose as a whole;
- (2) Analysis into parts, and teaching each part separately;
- (3) Final synthesis into the whole.

Standard Lessons. It is possible for training to be standardised down to the smallest detail, and lectures or lessons prepared and duplicated by senior instructors and kept in cold storage for use when required. In effect this means that the training officer does the preparation for the class instructor. This may save time and may produce greater efficiency, but is not recommended, as it robs the junior instructor of any opportunity for initiative and destroys his enthusiasm for his task.

A standard lesson given without zeal or conviction is far less effective than an instructor's own lesson given in his

own way to suit a particular class. The lesson 'off the peg' should be regarded as useful in an emergency.

In planning a syllabus the instructor will find that, no matter how well he studies the importance of tempo, fatigue or inhibition, a number of other factors enter into the problem which have to be dealt with by compromise, goodwill and common sense. For instance, other classes may want to use the workshop, the film projector, or the drawing office at the same time. Again, some of the principles outlined may appear to be in conflict. It may be more important to the instructor to ignore the principle of fatigue in order to gain a valuable tempo. Variety in teaching may be achieved only by risking a little inhibition or confusion in some members of the class.

CHAPTER VIII

The Various Methods of Instruction

Instruction can be imparted through several different media, and it is important to use the most suitable one for any particular purpose.

THE LECTURE

The lecture has many limitations in usefulness but nevertheless has a place in technical training. For example, a lecture by the Medical Officer is usually the most satisfactory way of instructing a class on some aspect of industrial hygiene. Demonstrations, discussion and practice by the class might be out of place here.

A 'Pep' talk by the Managing Director or training supervisor could take the form of a lecture, as the objects of these talks would be to get men to think in a certain way; to motivate them, rather than to impart knowledge or skills.

A lecturer, if he is to achieve the object of inspiring men to be more industrious, loyal, or punctual, must not only be a good lecturer, but an able and experienced leader.

Lectures have several advantages: one instructor can handle a large class of a hundred or more, he can cover a great deal of ground in his own way, no equipment need be used, and a lecture well prepared can be repeated without any great effort on the part of the lecturer by way of further preparation.

The disadvantages are that without some participation by the class, knowledge gained by passive listening to a

factual lecture is not readily assimilated, and saturation sets in after a few minutes. The lecture offers no scope for class participation and *training* of men in skills and habits of thought. The advantages benefit the instructor, the disadvantages penalise the class.

The old-fashioned form of lecture consisting of sixty minutes of monologue has no place in technical instruction. The class is passive, there is no variety, and boredom readily descends upon the class. Experiments on classes show that after a period of sixty minutes of talking, only a fraction of the class can remember any more than could have been stated succinctly in ten minutes.

The lecture can be given its maximum effectiveness by reducing the time from sixty minutes to thirty minutes of well-planned talk, broken up into sections of ten minutes each by visual aids, periods of questioning, etc. to stave off saturation.

Technical training is mainly concerned with people *doing* things and therefore the most effective medium is that which presents the syllabus in the most practical way.

The least effective medium is one which uses only words—without the support of things to see or do. Note, for example, the difference on a class of the two methods of approach to a lesson or a course on First Aid.

I. 'I am going to lecture this afternoon on accidents, and what to do in emergencies. As you probably know, accidents often happen and people lose their heads and do the wrong thing. The first thing to do when you find yourself in the position of having to render first aid is to, etc. etc.' After fifteen minutes of words the class will be losing interest.

II. 'Under this blanket I have prepared a casualty in a rather serious accident (previously arrange a case of bleeding or a compound fracture). You are alone. What will you look for first and what action will you take? I am going to ask you some questions, then ask someone to deal with the situation. The others can later

discuss what was done. I will then demonstrate a few points to illustrate routine procedure when accidents are first discovered.' Here the class are active and interested: *sense appeal* is used.

In deciding how to transmit a lesson, the choice of method is often limited by consideration of size of class, time, and equipment available, but a keen instructor will overcome these limitations and insist on using the most effective medium.

It has been emphasised that in technical training, the factual lecture should be avoided as far as possible, but if for reasons of time, and ease of preparation, the lecture is somewhat reluctantly decided upon, then make use of drama, surprise, variety, questions, visual aids, as discussed in Chapters II and III.

Skills cannot be taught by lecturing. Techniques can sometimes be introduced by a lecture, but time is often wasted by trying to describe in the classroom, processes and operations that can far more satisfactorily be demonstrated and practised on the job or in the workshop. Talk and chalk, gestures and diagrams, should be confined to subjects and aspects of training that cannot be taught by more practical, lively and active methods.

With a dull and difficult class of apprentices in the lower grades of work the lecture calls forth a response mainly of passivity, but a bright well-motivated class will stand up to a lecture, and assimilate the factual material.

MUTUAL LECTURES

The class is given some time to prepare various subjects, either individually or in syndicates of three, and then someone is selected to give a short lecture, followed by others. This method needs careful handling and supervision. These can be used only when the class consists of men of fairly mature experience or advanced ability.

Advantages. The class activity in preparing and taking part in actual lecturing ensures good instruction and assimilation. Character qualities—such as leadership initiative—are given some scope for development.

Disadvantages. The disadvantages of the method are that much more time is required than for a straight lecture. If a large class is split up extra instructors will be needed. If a student does not make a success of his lecture, the ground will have to be covered again by the instructor.

The advantages benefit the student—the disadvantages affect the instructor.

THE LESSON

This is a suitable name for the normal type of class teaching in classes of ten to twenty men lasting from thirty to fifty minutes, and making use of explanation, demonstration and practice, in varying proportions to suit the teaching of knowledge, skills or techniques. It should be characterised by close co-operation between teacher and taught, with each man being given individual attention from time to time.

As we have seen in Chapters II and III, the success or otherwise of a lesson depends on preparation and the skill of the instructor.

THE DISCUSSION

This is a useful method of stimulating thought and interest in a subject or topic, and is generally conducted in small groups under a leader or chairman. Discussion groups contribute much toward character-development and training for posts of responsibility in dealing with people. In *Training within Industry for Supervisors* the discussion group technique is used extensively.

1. *Object.* To provide an opportunity for men under training to discuss, in a free and informal atmosphere, the various

problems of the work and future. By expressing their opinions, the men are trained to think for themselves, and under proper guidance from the group leaders, the discussion group may help to achieve the following:

- (a) Individuals will be forced to face facts, and to give weight to the opinions and experiences of others;
- (b) Opinions will become more responsible and criticism will become more constructive and less destructive;
- (c) Industrial problems will be viewed from a national rather than from an individual angle, and a sense of civic responsibility will be developed.

2. *Aims of the Group Leader or Chairman.* These are:

- (a) To arouse the group's interest, to keep the discussion general, balanced and relevant;
- (b) To stimulate thought and discussion on the topic;
- (c) To give the group information when necessary.

It is more important to arouse interest than to attempt to give a great deal of information. The interested will inevitably seek information, and a great deal of information will be contributed by the group, once interest is roused. The aim should be, therefore, to achieve maximum collaboration in the group.

3. *Hints for the Chairman or Leader.* He should see that the class is comfortable. He should state the subject, its various phases, and decide in what order those phases will be taken. Then he should put a question to a member of the group, to begin the discussion.

Thereafter, he should keep the discussion going by:

- (1) Asking for further answers to his question;
- (2) Asking opinions on the first answer he receives;
- (3) Putting out new questions.

He should see that:

- (a) Over-enthusiastic talkers do not predominate;

(b) Over-timid talkers do not remain silent;

(c) All points of view are discussed—if necessary putting propositions opposing the dominating view;

(d) The discussion does not wander from the main subject.

He must get the class to see the implications of any opinions expressed. He should endeavour never to put forward his own views.

It is not necessary, though it is helpful, for the leader to have detailed knowledge of his subject, but it is *vital* for him to think the subject over to split it into convenient sections, and to anticipate, generally, the opinions that may be expressed and to realise their implications.

4. *Preparation.* Every discussion requires preparation by the group leader, as the success of it will depend on how the subject is initially presented by him and how it is controlled.

(a) *Subject for Discussion.* This should be a controversial problem of human relations or concerned with social or industrial matters. Articles in newspapers and magazines will serve as suitable bases for discussion.

(b) *Selection.* This is a matter of some difficulty and the selection of material must be made with care. Having read the source of information, the group leader should then extract the most important points. For an ordinary discussion, it is rarely necessary to have more than three or four points though it is as well to have one or two in reserve in case interest flags in the ones originally chosen. These points should then be arranged in a natural sequence, so that the discussion on one point will lead automatically to the other. It is not essential to assimilate a mass of facts around each point, for it is more important to collect thoughts around the subject and decide on an attractive and interesting method of presenting each one.

5. *Hints on Technique.* (a) There is no standard method of running a discussion group for the method used will be determined partly by the intrinsic difficulty of the subject, partly by the background knowledge and intelligence of the group and partly also by the skill and experience of the group leader. The latter must experiment to get the best out of himself and out of the group. The following factors should be borne in mind:

(i) The leader's personal opinions do not necessarily matter as the whole object is to encourage the group to express theirs. If, therefore, a factual talk is unavoidable, it should be as short as possible.

(ii) A discussion group is not a lecture nor a debate, nor an informal conversation, though certain aspects of all three can enter into the proceedings.

(b) As stated above, there is no standard method, but the following are two suggestions:

Having given the group a general idea of the topic for discussion, the leader passes the subject to the group by means of a question. These opening questions should be expressed in clear and simple terms and should be addressed to the men who can easily answer them. This starts the ball rolling, and when he feels that sufficient attention has been paid to this particular point, he will pass on to the other points in a natural way, as opportunity offers. At the end the leader should summarise what has been said so that members can go away with a clear idea of the arguments brought up on every side. The purpose is not necessarily to arrive at any definite decision. Alternatively, if the leader is certain that no discussion is possible without a preliminary talk by him in order to give the group the necessary background information, then this talk should be as factual as possible. But even during this talk, the leader should do his utmost to get the group to co-operate, and he should try to build his talk on fragments of information and personal experiences, obtained from the group. The background knowledge having been imparted, the leader should then

state what questions for discussion arise from his talk and he will then start the discussion as in (a) above. A good group leader will never say, 'That finishes the talk, now we will start the discussion.' The discussion should follow and spring from the talk in a natural manner. A summary of arguments at the end is again recommended.

(c) The group leader's job is to stimulate the discussion, to see that each member has an opportunity of speaking, and to encourage all to co-operate. Tact and sympathy are essential if the silent members in particular are to voice their opinions.

(d) The leader should generally avoid answering questions put to him. The questions should be passed to other members of the group for answering, for that is the only way to achieve maximum co-operation. By continually answering questions the leader separates himself from the group and the thread of the discussion becomes broken.

(e) The leader should always endeavour to keep the discussion within the limits originally laid down by him. There should be no rigidity here, for often relevant points are brought up by members of the group, which have more bearing on the subject than the points originally laid down by the leader. It is essential, however, to keep to the main subject under discussion.

(f) Do not allow cross-talk amongst individual members of the group. All remarks should preferably be addressed to the leader or chairman.

(g) The leader should use tact in discouraging voluble members from monopolising the discussion. This should be done with great care, as the talkative member is always useful in opening or reviving the discussion when it starts to flag.

(h) The successful discussion is one which is carried on as a topic of conversation in the canteen afterwards.

BE ON YOUR GUARD AGAINST THE FOLLOWING:

1. *The Man with a Mission.* He is much more concerned in inducing the other members of the group to agree with him than to convince them that what he says is sound. He usually employs exaggerated modes of expression and his frequent use of emotional language may serve to impress some of the people in the group.

2. *The Yes or No Man.* It is a grave mistake in some circumstances to try to draw a sharp line of demarcation. This is what logicians call 'The fallacy of either black or white'. Truth has many sides and in many circumstances it would be impossible to give a direct and definite Yes or No. Could one, for example, draw a sharp line of demarcation between the sane and the insane or between the intelligent and the unintelligent.

3. *The Man with an Isolated Example.* A man is often tempted to generalise from one particular case, and you will generally find that it is not something that happened to him personally—it is usually his uncle's friend's brother-in-law, etc. When someone brings up a selected instance, you should endeavour to find out whether it is a representative and fair case by asking the other members of the group.

4. *The Man who lays down the Law.* When you hear someone starting an argument with such phrases as: 'It is indisputably true that——', 'Everyone knows that——', or 'No reasonable person can doubt that——', then you can suspect that this is a substitute for any convincing argument or demonstration.

5. *The Man with favourite Clichés.* A cliché that frequently recurs in speeches and the press is 'Vested Interest'.

The following lines by Sir Alan Herbert* deal with this one:

To a Parrot

A 'vested interest' is—what?
 Show me an interest that is not.
 If I save sixpence in a chest,
 That is a vested interest:
 You have, in your beloved wife,
 A vested interest for life.
 George has another in his cat—
 But we are none the worse for that.
 I beg you, do not use again
 Expressions you cannot explain.

6. *The Man who Counters an Argument by misquoting it.* It is an old trick to misquote or to extend immoderately an argument which it is intended to counteract. The extension often destroys the argument and we generally find that this type of man will also add false imputations.

THE PLAYLET

A little play-acting has a great appeal, and the short sketch or playlet of even only a few minutes' duration, designed to instruct the audience, is a refreshing relief from the lecture, and a valuable part of the instructor's stock-in-trade.

Examples have already been suggested earlier—pages 25, 53, 155. Briefly, the advantages are these:

Interest is easily roused. It teaches visually and aurally and is useful in giving a background idea in teaching techniques which have often to be acquired by imitating the example of experienced men: for example in demonstrating the correct bearing and attitude of a foreman or supervisor in dealing with various man-management problems. The

* Quoted by kind permission of the Author and of Messrs. Methuen & Co. Ltd., from *Light the Lights*.

film 'Introducing the New Worker' teaches several man-management techniques by simple and effective dramatisation of various situations.

Playlets can be performed before large classes. They create a pleasant atmosphere in training which sweetens a tired or 'browned-off' class. Properly carried out, they make for good friendly relations between teachers and taught as the class see the instructor in a new light and see a little more of his human side.

The disadvantages are in the time and effort required for production, and unless care be taken, the dramatic or humorous effects tend to dominate the effort, and may even obscure the instructional points or the main object.

The wrong-way demonstration put on as a playlet can readily develop into a piece of slapstick comedy, and then, although it provides good fun, it teaches very little (see p. 56). The demonstration is dealt with on page 166.

The playlet is clearly more suited to teaching techniques than skills or knowledge.

Playlets on problems in personal relations and the techniques of man-management can be effectively followed by a discussion. Play-acting is sometimes called, perhaps more appropriately, 'Role playing': for example, a foreman dealing with the aggrieved workman. This can be put on either as a spontaneous situation in the form of a test, with no preparation, or it can be a rehearsed situation and put on as a polished performance to show how the situation might be effectively handled.

There are opportunities of teaching ordinary lessons and some factual material by this medium. Let someone represent the trainee on the stage. He could act the part of a visitor to the works, or a new managing director going round asking questions of the foreman and some workmen, who explain correctly and skilfully various intricate points connected with their work. The B.B.C. makes excellent use of such

little scenes when explaining technical matters to its listeners or viewers. The inquiring visitor or important person going round the job must be very inquisitive, somewhat ignorant, and just a little stupid so that the slower members of the class can follow, and all the questions they want to ask are raised.

In a playlet, the instructor or someone should be in control on the stage or set, who can maintain some contact with the audience, and hammer home a point, by a summary, or by breaking in on the audience, or by rounding on them in the music-hall style. The best effect of a playlet is achieved if it has incidental surprises and a climax.

Good casting is most important and it is often necessary to prepare a script to suit the personalities available, but remember over-acting is more common, and even worse than playing woodenly.

The producer should ensure that players speak slowly and distinctly, and act naturally. The playlet should be a very simple affair with perhaps a few makeshift props and a hundred square feet or so of free space.

The script can be in note form and players may, within limits, use their own words.

TUTORIAL PERIODS

These are useful in that they encourage students to learn their own way with the instructor available for consultation and advice.

In learning by rote, for example, sets of figures or sizes, the student must make his own special effort as was mentioned on p. 80. Opportunities for private study should be provided in any course as a part of the process of assimilation.

BRAINS TRUSTS

These can sometimes be arranged with good effect in order to provide background knowledge or a general survey of a

subject, and can be designed to replace the standard general-interest lecture. They can be used to give junior men an insight into some of the scientific and research aspects of the firm. Brains trusts must be first-class, and the personalities involved must be experts, e.g. the scientific research staff might stand up to questions on the use of radio-active tracer elements in industry. The development engineers might deal with questions of future trends in design. All kinds of technical and scientific problems could be aired and referred to experts, either from within the firm or from specialists brought in from outside.

THE DEMONSTRATION

This plays a prominent part in technical training. It is the link between explanation and practice, and makes use of man's natural inclination to imitate. The interest, even of large classes, can readily be aroused by a good demonstration.

There are some disadvantages:

A good demonstration requires a great deal of time and trouble for proper preparation.

There is always a danger that a demonstration will display several features simultaneously, and a person can watch only one thing at a time.

Some demonstrations suffer from a too rapid sequence of events, so that something new happens before the preceding point is assimilated.

A demonstration of a skill for imitation by the trainee should not last too long, as the only way to learn a skill is by doing—not by seeing.

A demonstration that has for its object motivation—for example watching the works expert in armature winding or foundry work—need have no such short time limit as the object here is to show an expert at work, and that is like looking at a work of art, a pleasure in itself.

A trainee is not concerned with a demonstration as a demonstration, but normally focuses his attention on the

demonstrator, and puts himself in his place and prepares to *imitate* him. This is best done if the skill is demonstrated slowly and in easily assimilated steps.

A demonstration is in danger of showing too much, going too fast, and continuing too long. It must work perfectly, for anything which fails in a demonstration seriously detracts from it.

'Wrong-way' demonstrations should preferably be a representation of a true-to-life effort rather than a caricature. As previously mentioned, the 'crazy gang' version of a wrong-way demonstration can be uproariously funny but teaches practically nothing.

The most effective demonstration of a wrong way is to show exactly how it is wrongly done, so that when the mistakes are pointed out and discussed, the class feel that they have been saved from that error.

Demonstrations to large classes may profit from the judicious use of an amplifier and loud-speaker. This ensures that everyone can hear, and the big voice speaks with some sort of other-worldly authority, quite unconnected with that of any instructor.

THE FILM

This is such an important medium of instruction that a separate chapter is devoted to it (Chapter IX).

INSTRUCTIONAL VISITS

These need proper preparation and 'follow-up'. Approach the senior official of the place to be visited and fix the time, place, and the conditions of the visit in writing, stating the numbers concerned and the general object of the visit. Thank him after the visit. Prepare the party for the visit with an explanation of what they are to see, giving some relevant facts and figures. It is often useful to give to various members a few special points to study, and after the visit

get them to give the class their findings which can then be discussed. This rouses interest and ensures that questions will be asked about the more important features.

RECORDED SOUND

Although considered here as a medium of instruction, recorded sound is more likely to be used as an aid to instruction in a lesson or demonstration, as rarely could a whole period be devoted to listening to a recording. Modern instruments using magnetic tapes or wires make recording simple, cheap, and an effective medium of instruction for certain types of training involving a technique, such as using the telephone, or the recognition of sounds. Examples are the sound of machinery under various conditions and the recognition of faults. Recordings of lessons, discussions, meetings, interviews of all kinds, man-management technique (such as issuing instructions or handling men under various circumstances) can be put to good use in training instructors, supervisors or foremen. The recordings can be used to demonstrate good points in technique or to eradicate faults. They can also be incorporated into playlets with good effect. (See pages 25, 53.)

It is salutary, and quite often humbling, for an instructor or foreman to hear a recording of his own voice. We all seem to possess vowel sounds and affectations in our speech that we little suspect until we hear ourselves as others hear us.

Guard against using a sound-recording as a substitute for a more realistic and practical demonstration by the instructor. A recording can be of value and convenience to the instructor by bringing to the class-room at the required moment sounds, notes, noises, speech or music.

CHAPTER IX

The Use of the Film in Technical Training

The film is a comparatively new medium for instruction, and as its advantages and limitations become more clearly known and understood, it promises to be a valuable aid to technical training. It is steadily growing in scope and usefulness, and investigations are still in progress to assess the most effective ways of using the film for training.

The *advantages* of the film over other mediums are briefly these: It brings the outside world into the class-room. The instructor's task is lightened, but not eliminated. Expert treatment of a subject, and the results of much skill and time in planning, are made available to the class. The performance runs reliably from beginning to end. The film is a means of introducing variety into the instruction. Large classes can be dealt with. Repetition can be easily effected as required. The attention of the class can be focussed on a small area of interest, by 'close-ups' and magnification. All the tricks of emphasis known to film-makers can be used to make vivid impressions on the class. It can survey a broad field of study in a short time and can be used to reveal and explain movements vital to the proper understanding of many subjects, through the use of slow motion, and time-lapse techniques.

Information can be recorded and shown to a class that would be impossible or perhaps dangerous by any other means, as the camera can operate in places inaccessible to people. It can bring together in proper juxtaposition scenes

and sequences that would require much time and effort if the class had to follow the route taken by the camera, e.g. different sections and processes in a large power station or works.

The film is ideally suited for motivating people or influencing their outlook. The tremendous possibility of dramatisation and portraying problems in the field of human relations, make the film of exceptional value, for example in induction training, and in providing background information for a course.

The *disadvantages* are: There is no opportunity during the showing of a film for active participation by the class. Contact with the teacher is lost or weakened, and he cannot even adjust the pace of the film to the rate at which the class can learn. There is thus a serious danger of saturation and poor assimilation in factual films. The cinema is inseparably associated with relaxation and entertainment, so that students are tempted to regard a period in which films are shown as one calling for no effort. A film can impart only experience through the eyes and ears and is therefore of very limited value in teaching manual skills.

A TRAINING FILM MUST HAVE A CLEARLY DEFINED OBJECT

One of the hall-marks of a successful lesson, lecture, or demonstration is a *definite and limited object* (Chapter I). The same is true of a training film which should neither attempt too much nor to cater for too many kinds of audience. A statement of the object should include a definition of the audience for which the film is designed, e.g. 'To instruct British farmers to recognise and deal with the Colorado Beetle'.

The film made with a strictly limited objective is likely to achieve even more than its specified purpose, but a film that attempts to instruct a vague audience in an ill-defined skill or technique will fail altogether.

Two simple questions must be asked of an instructional

film: What is its object? How successful is it in achieving this object?

Frequently the title of a film will indicate the object of the film, e.g. 'Precise Measurements for Engineers'.

Some instructional films made by industrial companies suffer from a lack of a clearly defined object. The worst contain some attempt at giving instruction in a manual skill, mixed with a wealth of information and factual knowledge, and throughout the whole film there is a feeling that an attempt is being made to carry on some sort of sales propaganda. Such films seem to be more concerned with impressing and justifying themselves to the Board of Directors than with training workers.

Film makers should be guided by a clear and limited objective at all stages of production: at the stage of planning the scripts, and during consultations between subject specialists, educational specialists, and film specialists.

It has been found that pre-production planning is not always an unqualified success when done in committees as this often leads to unsatisfactory compromises.

A training film generally falls into one of four types depending on whether its main object is (1) to give technical information (knowledge), e.g. 'Works Information', 'Precise Measurements for Engineers', 'Atomisation', 'Latitude and Longitude'; (2) to demonstrate a physical skill, e.g. 'Files and Filing', 'Welding'; (3) to demonstrate a technique, e.g. 'Introducing the New Worker', 'Handling Ships'; (4) to influence ways of thinking (motivation), e.g. 'The Story of Printing', 'Co-operative Research in Industry' and 'Family Portrait'.

The film is pre-eminent and unique in its capacity to instruct and motivate people in matters where human relations and personnel problems arise, and topics under (3) and (4), including problems of human relations, lend

themselves more readily and usefully to the medium of the film rather than topics under (1) and (2).

In a course for foremen and supervisors, a number of short films depicting problems in human relationships can very profitably be shown and then discussed.

A FILM FOR A SPECIFIC PURPOSE

A training film must be shown in a logical place in the syllabus and not put on when the class shows signs of boredom or the instructor has an odd half-hour to fill in.

One of the problems confronting a training supervisor is to select suitable films for showing. Some companies and industries have well-catalogued film 'libraries' and are aware of the many sources of supply of technical films. The Scientific Film Association has compiled a 'List of Films for Training in Industry' and this gives a brief description of over 400 films. The Universal Decimal Classification, as published by the British Standards Institution, is followed.

The first consideration in selecting a film must be the answer to the question—'How does the object of a particular film fit in with the object of the course, or the period of instruction?' Films are cheaper when bought or hired 'off the peg' than when 'made to measure'. Most film-users have to use the best films that are available for their purpose; they cannot indulge in the luxury of having a film made specially to meet their particular requirements.

There is still need for an up-to-date and comprehensive classified catalogue of scientific and technical films, which will give training officers all essential details of technical films. Users of technical films will find it advantageous to maintain some simple assessment cards of technical films seen. A card-index will help future instructors in selecting films. A suggested form is given below and is based on the analysis of a training film into its main characteristics as shown in Fig. 36.

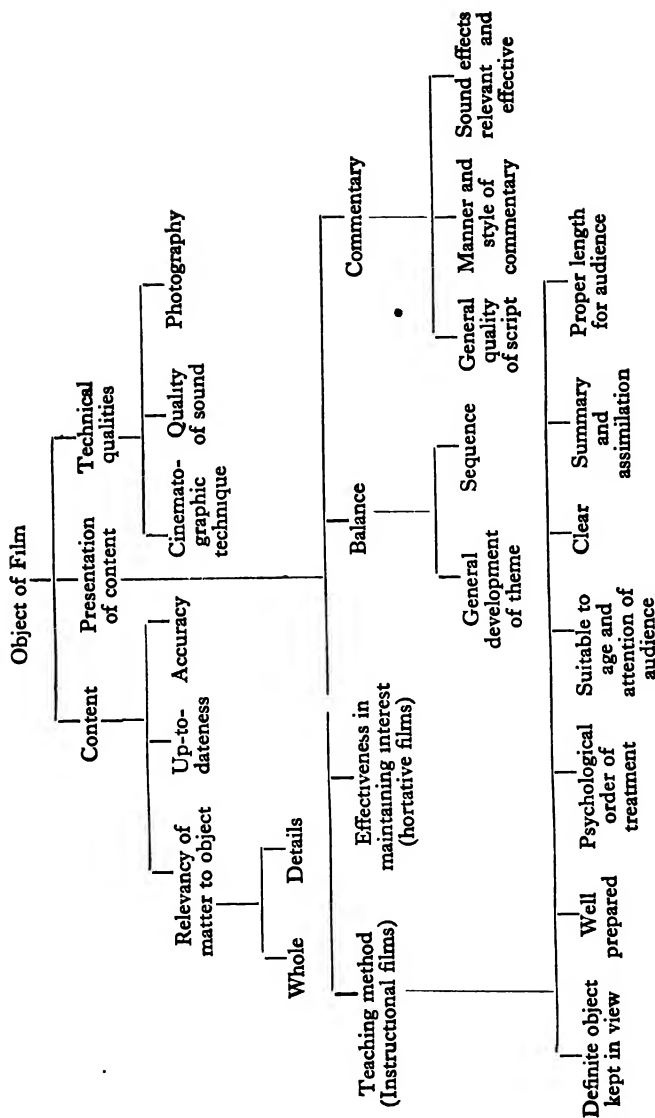


FIG. 36. Film appraisal

174 TECHNIQUES OF TECHNICAL TRAINING

SUGGESTED APPRAISAL FORM FOR SCIENTIFIC AND TECHNICAL FILMS

Title of film—

Object of film including a definition of the audience or audiences for whom the film is intended—

Qualification of Viewers (cross out whatever does not apply and add a note if necessary)—

Professionally qualified in subject-matter

Educationist

Film Producer or Specialist in Cinematography

Typical of audience for which film is intended

	Yes	Comment, if Doubtful	No
<i>Film Content</i>			
Was the material well selected and relevant to the object of the film?			
Was it accurate and up to date?			
<i>Presentation of Content</i>			
Was the presentation balanced with good sequence?			
Was interest well maintained?			
Was the script well written?			
Was the commentary well spoken?			
<i>Technical Qualities</i>			
Were the sound effects good?			
Were the photographic and cinematographic qualities good?			
<i>General Success of Film</i>			
Was the film successful in what it set out to do?			
<i>Audience Suitability</i>			
Primary schools			
Secondary schools			
University and Technical Colleges			
Specialists in subject			
Industry—Management Technicians			
Craftsmen			

Further Comments if any

An instructor should always see and study the film he intends to show before showing it to the class. Titles can be misleading, and careful preparation on the part of the instructor is necessary for a satisfactory film period.

HOW TO SHOW A FILM

The technical teaching film does not render the instructor redundant; there is a good deal of preparation work to be done before a technical teaching film can be shown effectively and showing a film can often follow with advantage the same steps as for a piece of instruction.

With the object clear:

<i>Prepare</i>	<i>The subject-matter</i> (study film beforehand). If necessary, divide the film when selected into sequences of about ten minutes each, and select problems and questions to ask the class.
	<i>The minds of the class</i> (lead up to film and introduce it at right stage in the syllabus). Give statement of the object to the class. Warn class of tests and questions to follow.
	<i>Material and equipment</i> (lighting, microphone, projector all working properly) so that no hitches occur. Understanding with the projectionist, using a coloured light code.
<i>Presentation</i>	This should ideally be done in ten-minute sequences with breaks for discussion to avoid saturation, then repeat. (See p. 126, Chapter VII).
<i>Assimilation</i>	This can be assured by simple tests on the subject-matter of the film, giving back, question and answer. Summaries by the instructor. Note-taking. Drive home each point by summaries, and 'part-way' summaries.

Films designed to motivate the class should be complete in themselves and should be shown through without interruption or comment except for a discussion at the end if this is likely to be useful.

General points. There is a danger of attempting to cram too much into a teaching film. Generally a film of twenty minutes' duration will attempt to teach far more than would be attempted in forty minutes in the class-room.

The silent technical film is sometimes to be preferred to the sound film, as the instructor, after proper preparation, can supply the commentary to suit his particular lesson and local conditions. Sound films can always be run as silent films if the instructor so requires. For large classes a microphone and amplifier is recommended for the instructor. One hundred words per minute seems to be the optimum speed for a commentary in a teaching film, and the commentary should preferably be a little in advance of the picture so that cue words should appear to trigger off the picture. The imperative form of address in a commentary appears to be more effective than the third person passive.

There is no advantage to be gained from a musical background, and unless the subject is concerned with colour, a coloured film has no great advantage over monochrome except in animated diagrams where colour can increase clarity and vividness. Film devices for gaining attention which are not relevant to the subject-matter serve no useful purpose.

Some films should be shown twice for full effect, and in order to ensure that this is done without technical inconvenience, the splicing of two copies of a film together has been recommended. Some films, especially those of the fast-moving kind packed with facts, are more useful for revision purposes than for initial instruction in a subject.

The efficiency of the film is greatly reduced by technical

hitches, poor projection, bad acoustics, inadequately controlled lighting, lack of ventilation, and poor seating arrangements. Adequate preparation should eliminate these.

The instructor, or whoever is in charge of the screening, should be out of sight and will find it advantageous to have some simple means of communicating with the projectionist. One way is to use three small coloured bulbs and some code of signals, thus:

Green	..	..	..	Out lights—start film.
Red	..	..	..	Stop film—on lights.
White	..	..	..	Increase sound volume.
Red and Green	..	..	..	Decrease sound volume.
Red and White	..	..	..	Switch over from sound track to microphone.
Green and White	..	..	..	Run same film through again.
Red, Green and White	..	..	..	Show the next film.

A film can be used effectively in job analysis, time-and-motion studies, and in research on teaching techniques. It provides many opportunities for conducting investigations on audience reactions and has opened up many fruitful lines of inquiry.

The film should not be used just because a film exists on the subject being taught. Some films attempt to teach what can clearly be taught more successfully by other methods, e.g. by actual demonstration and practice on the real thing.

THE FILM LOOP

This is simply a device for projecting repeatedly a film which has had its end joined to its beginning, and by this means complicated physical skills or movements of mechanical parts can be isolated as a short sequence and repeated as often as required. Several loops can be used to ensure mastery of each operation in isolation, and then a complete film shown of the whole process. This is an excellent way of

presenting such subjects as the working of the four-stroke engine, the gear-box or the differential gear of a car.

A detailed account of the production and use of a loop film in industry and for teaching and research is given in *The Loop Film* by R. A. N. Smith.

THE FILM FLASH

Occasions may arise in a course when a few minutes of film can be used with great effect to create an atmosphere, or to motivate a class to serve as an introduction to a lecture or a course.

Finally it must be borne in mind that the young trainee is today acutely film-minded and demands a high technical standard from any film if the production is to claim his attention and approval.

TELEVISION

As a medium of instruction this is in its infancy, but it has numerous possibilities for demonstrating techniques to groups of specialists in widely separated areas, and for bringing into the shop or class-room outstanding technical events of the outside world, at the actual moment the events are taking place.

Television provides a strong 'here-and-now' interest to certain events, but if simultaneity is of no importance, then television has no special advantages over the film. Television when used to broadcast events recorded on film is not a new medium of instruction, but a new and valuable method of distributing instructional films.

CHAPTER X

Further Training Aids

VISUAL AIDS TO INSTRUCTION

In Chapter II stress was laid on the value of using the sense of sight in instruction. Visual aids are essentially aids to understanding and learning and are not to be confused with aids to vision! They focus attention, increase interest and introduce variety and change, but it is part of the instructor's art to choose his aids to suit his particular purpose. The working of a four-stroke petrol engine could be explained by using a real working engine, a sectionalised engine, a model, a film, a film-strip, an engineering drawing or blackboard sketches.

A good sectionalised engine would probably be the best choice, but this could be supported by other aids, e.g. a film-strip and blackboard sketches. The real thing or an actual part being studied is generally a better visual aid than a representation and should be used whenever possible. Models and three-dimensional representations are generally to be preferred to pictures and diagrams.

Here are a few points to be observed in selecting or preparing visual aids. They should aid and not dominate the instruction; be simple with all non-essential details and lettering eliminated; preferably be coloured, using two or three bold colours, provided the colouring separates parts and adds to clearness; concentrate on one or two essentials or key parts at a time, and then build these parts into the whole; be used to supplement information to be gained by

handling the real thing, never as a substitute for it; should be shown to the class at the right moment, and then covered up or put away as soon as they have served their purpose. To leave visual aids to decorate the class-room is to invite inattention, so keep the front and side walls of the instruction-room free from any permanent posters or pin-ups.

Posters and Wall Charts that are intended to rouse the interest of trainees or to motivate them may, however, advantageously be displayed in workshops, on notice-boards, or at the foot of a stairway. Charts displayed in this way should be changed regularly, or interest will wane. The type of chart for this function is of a style different from the class-room visual aid. A wall chart for permanent display may be an attempt to summarise a whole lesson or a course on a subject, and may contain a great deal of detail and

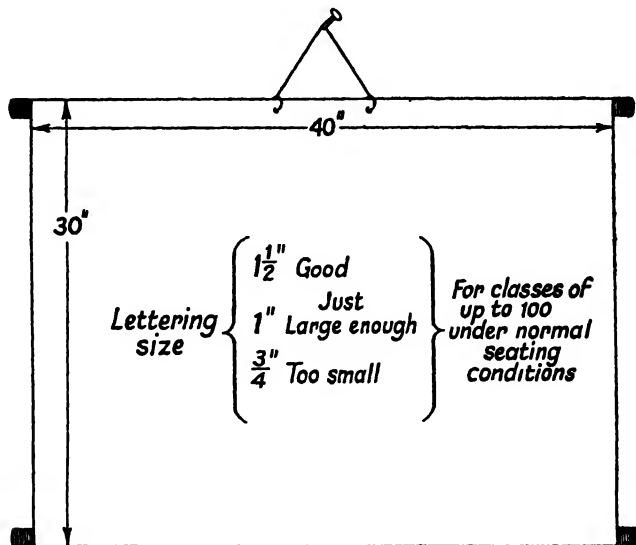


FIG. 37.

explanation. It should attract attention, and encourage people to look at it, and to study it in odd moments. Charts for use in formal instruction, however, should be simple, clear, easily seen by the class and have one main point. Charts and diagrams used for instruction must be big enough to be seen clearly but not so big as to be unwieldy.

Fig. 37 is an example of a good standard size for a chart.

Many firms supply charts on technical subjects, printed on paper of lightweight quality. Such charts when intended for constant use should be pasted on wall-boarding and varnished, or else mounted on linen and fitted with rollers.

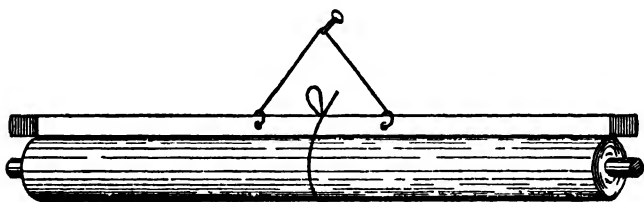


FIG. 38.

This is best done by a professional map or picture mounter but a simple expedient is to tack a lath to the top and bottom of the chart so that it can be rolled up, tied with a slip-knot, and let down instantly before the class when required (Fig. 38).

Charts are specially useful when shown in a sequence, to illustrate the systematic build-up of the subject or piece of mechanism. Sectionalised drawings showing hidden parts are also very useful.

When charts or models have to be changed several times, the help of an assistant can greatly improve a lecture or lesson. The instructor should ensure that the attention of the class is focussed on one thing at a time.

Blackboards. These should be black but are often grey and patchy. Indian ink will renew the surface of a worn board. Some instructors put up a very poor show at the blackboard, with poor, small, spidery drawings and writing, which indicate a certain lack of confidence in their ability. Here are a few tips to bear in mind when performing on the blackboard.

If you are right-handed, have the blackboard on your left as you stand facing the class. Stand squarely before the board and write with your right elbow held well up. Move the whole arm, instead of just the wrist. In diagrams, make your strokes from left to right, and from top to bottom. Walk across the blackboard instead of standing at one side. Do not speak to the blackboard. The class will not be able to hear you and no notice will be taken of anything said to the blackboard. There can be exceptions to this rule, provided what is said is in the nature of casual unimportant patter that is soothing rather than distracting. When you have finished the blackboard work, stand clear, and use a pointer.

Dark-coloured chalks show up very badly on a blackboard. Yellow is the colour most easily seen by the eye, then white, pink, red, green, blue, brown, purple. Use white or yellow for all writing on the blackboard. Use a damp cloth for cleaning.

A good tip for the instructor inexperienced in the use of a blackboard, or even an experienced instructor who has to build up a complicated diagram, such as a radio circuit, is to draw the diagram carefully beforehand, then run a pencil line over the chalk lines, and rub the chalk off with a duster. The pencil lines remain; they are invisible to the class but not to the instructor. Your performance on the blackboard will be carried out well without effort, and without having to consult the book or notes every few seconds when building up, section by section, the complicated diagram.

A small, light, three-ply blackboard, say two feet square, is often useful in the course of practical work in the shop,

or for a piece of outdoor instruction for explaining a technical point to a group. It is better than the hastily produced back of an envelope or a cramped sketch done in pencil on the nearest piece of white paint. Keep a portable blackboard available for such occasions.

While on the subject of blackboards, do not become too attached to your blackboard and cling to it permanently in what has been aptly described as 'the coffee-pot attitude'. This can become a distracting mannerism.

THE DIASCOPE OR MAGIC LANTERN

The magic lantern is still a great convenience in technical teaching. It can project slides or photographs of diagrams on the screen for a large number to see. Slides can be made as required from the lecturer's own material, or made from illustrations and diagrams in text-books, using a small camera, some lantern plates, and facilities for developing and printing.

THE EPISCOPE

This is an optical device for projecting an image of a strongly illuminated picture or a small surface on to a screen. The optical system of an episcope is often partly combined with that of a magic lantern and the combination is called an EPIDIASCOPE. The size of the picture than can be projected is generally limited to about six inches square. It is a great convenience for a lecturer to project his own material drawn on cards in coloured inks, or to prepare and project summaries or notes on cards in typescript.

FILM-STRIPS

This is a convenient way of showing a series of pictures, diagrams and captions in a planned sequence. A film-strip projector is in effect a portable magic lantern or diascope with the slides joined together on film. The projector can be used also to show 2 in. \times 2 in. slides. The advantage of

slides over the film-strip is that the instructor is more free to vary the sequence and to make up his own lesson from a variety of slides.

Lecturer's notes are often provided with a film-strip, but the temptation to read these notes verbatim should be resisted or the performance will be wooden and impersonal. Prepare your own lesson and use the frames on the film-strip in the order you think best to suit your purpose. Further,

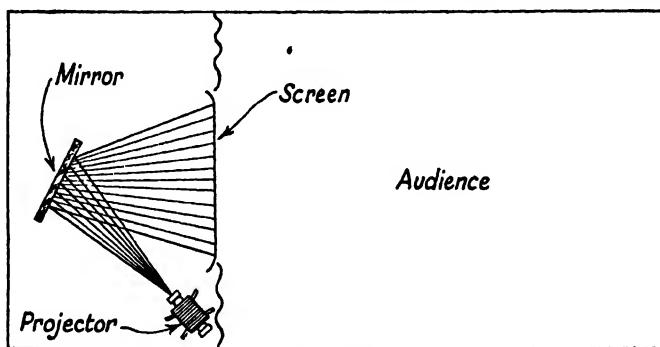


FIG. 39.

use all the teaching techniques as for an ordinary lesson, e.g. question and answer, tests to confirm learning, etc. The film or film-strip is an aid to a lesson and not the whole lesson.

Project in a room not entirely dark, otherwise contact is lost between the instructor and his class. Back-screen projection using a translucent screen and a mirror is recommended for showing film-strips and also has several advantages in projecting a film. Using this arrangement the room need not be dark, the class can take notes and the lecturer maintains contact with his class and has control over the projecting apparatus.

Alternatively the whole projecting equipment can be behind a partition where it causes no distraction to the class, as in Fig. 39.

It is sometimes convenient to draw coloured diagrams and simple visual aids on cards that can be projected through the episcope. A number of these cards can be joined on a long strip of paper and conveniently projected through the episcope in the correct sequence.

It is an advantage to have two-way switches controlling hall lights, one for the lecturer at the lectern, the other for the projectionist in the projection box.

INSTRUCTOR'S PREPARATION WORKSHOP

It is a great advantage to have a room set apart where all who are engaged in training or instructing can find ready to hand all they require to make up visual aids and models for use in their work. Such a workshop should contain such things as large sheets of paper, white, 30 in. \times 30 in.; large sheets of paper, coloured, 30 in. \times 30 in.; poster paints; brushes; ink, all colours; varnish; wooden laths; set of carpentry tools; cards for typescript or diagrams for use in the episcope; drawing instruments; duplicator.

A plate camera $3\frac{1}{4}$ in. \times $3\frac{1}{4}$ in. and facilities for developing and printing will be found useful in making lantern slides. A 35-mm. camera can be used to make slides for use in a film-strip projector. The external dimensions of these slides should be 2 in. \times 2 in. to fit the slide holder that is usually supplied with film-strip projectors.

NOTE-TAKING

Trainees on most technical courses should take notes of the essential points in their instruction to assist them in assimilating and recalling what has been learnt.

Lectures or lessons cannot be thoroughly assimilated during the period of instruction, and a memory aid in the form of notes that can later be studied is therefore essential. Notes are also valuable for making references for further reading and study.

Controlled note-taking during specific pauses during which the class takes notes that are later inspected or marked by the instructor may be useful. An inquiry was conducted on the value of uncontrolled note-taking as distinct from a précis given to the class. Two equally graded classes of fifty trainees (cadets) were the subjects. Class A were given précis for ten lectures; class B took uncontrolled notes of the same lectures. The result of the inquiry is as follows:

	A		B
Précis studied and memorised accurately.	8%	Notes re-written, studied and learnt.	4%
Précis read but not memorised.	82%	Notes read through and polished up.	8%
Précis not read, but filed and available when needed.	8%	Notes not looked at after period, but legible and of a certain limited value for reference.	64%
Précis lost.	2%	Notes lost or illegible.	24%

It is tempting to draw various conclusions from this, but the most obvious one is that uncontrolled note-taking is not worth the time and loss of attention involved.

It is therefore generally unwise to allow apprentices, and classes below first year university level, to take indiscriminate notes.

A good plan is to write on the blackboard the main headings and sub-headings as you go along, together with any new words or technical terms that need explaining. Many trainees will lack discrimination over what to write down, as they will be unable to discern what is important and what

is not until the subject can be seen as a whole—at the end of the period.

Invite the class to fill in the framework from what they have remembered. Meanwhile the class can ask questions on obscure points to refresh their memories.

At regular intervals the instructor should collect and examine notes to see they are satisfactory and should give marks on a simple five-point scale.

Notes should be dictated verbatim *only* to confirm important features such as summaries or definitions. The effect of verbatim note-taking decreases with its continued use. Three points dictated may be remembered, thirty will be a waste of time, and the habit violates all the rules of good instruction. The issue of pamphlets and duplicated notes are of little value unless the student is very keen, and will *use* these handouts intelligently.

In favour of students taking notes on their own, one should remember that each has his own style and method and way of forming associations with words and ideas. His own notes are more intimate and personal than text-books or duplicated notes.

As a rough guide, ten minutes in every forty could be used for note-taking during a lesson imparting knowledge in a technical subject.

Notes prepared by the instructor in the form of a précis of the material to be taught have two main uses—they guide the instructor and serve as a memory aid for the trainee.

For classes of average intelligence the tabulated précis should not contain more than 150 to 200 words. A longer précis cannot be memorised, and the trainee must be induced to read a précis to the end. It should be well arranged and clear even at a glance.

The issue of a skeleton précis which trainees may complete during the instructional period is a useful compromise between note-taking proper and the issue of condensed notes.

The skeleton précis is particularly useful in teaching technical subjects when diagrams can be printed, and the student must write his own explanations, names of parts and functions.

THE USE OF A REFERENCE LIBRARY

Seldom in the training programme is time devoted to explaining the value and importance of a library to the trainee as an aid to his studies.

A well-equipped works library makes reference material readily accessible and supplies a real need. It would contain such material as Text-books, Standard Reference Books, Periodicals, Digests, Manuals prepared by the firm, Employees' Handbooks (on the firm and its products). A useful pamphlet, *Reference Books for the Works Library*, by R. Brightman, gives a good selection of books.

Many trainees, particularly apprentices in technology, may aspire to study at university level, where their success will depend to a large extent on their ability to pursue private study. Training officers should therefore ensure that trainees are instructed early in their courses on how to use a library as a source of information and as an aid to study. The co-operation of the librarian in this would be most valuable. He could do this by giving practical demonstrations to trainees on the classification and recording of material. The library, just as any other aid to training, must be used skilfully.